

Issue 062

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Pacific Vision Institute began a series of in-depth workshops for Bay Area eye care community to educate about the subtleties of different refractive surgery options today. During the workshops, corneal and lens treatment parameters are discussed and cases are presented to illustrate decision making in patients based on age, refractive error, corneal and other ocular parameters. Indications and contra-indications for different procedures as well as advantages and limitations of various technologies are outlined. Practical recommendations are given on how to best counsel patients. We are truly inspired by the passion of our optometry colleagues to educate their patients and help them on their vision correction journey. Together, we share the same vision of excellence for all of our patients.

### Demystifying Today's Refractive Surgery Options

In 1890's, a Dutch ophthalmologist Dr. Herman Snellen performed the first refractive surgery when he made incision in the cornea to correct astigmatism. He was the same Dr. Snellen who invented the Snellen visual acuity chart, which, to this day, remains the most widespread method for measuring visual acuity. This co-invention of a method to quantify vision and a method to correct it set the stage for eye care to become one of the leading subspecialties in healthcare where we can measure a condition with great precision, proceed to correct it, and then accurately quantify the outcome. By quantifying the outcome, we can analyze it and proceed to either further refine the treatment or discontinue it.

Over the years, the developments in refractive surgery came in spurts, followed by incremental improvements in some techniques and technologies and phasing out of others. The three major milestones that have significantly influenced advances in surgical vision correction are: the discovery of intraocular lenses, the development of phacoemulsification lens extraction, and the invention of excimer lasers. Out of the three, the excimer laser has had the most profound impact on where we are in refractive surgery today. The sub micron precision of excimer laser-cornea interaction allowed, for the first time, extreme precision in correcting refractive error. It generated excitement in both patients and doctors and ushered in the era of pursuit of emmetropia for patients of all ages and refractive errors. As a result, there has been a rise and refinement of additional technologies such as lenticular extraction procedures, phakic IOLs, multifocal IOLs, and light adjustable lenses. While these recent methods do not currently achieve the extreme accuracy and safety of excimer laser treatments, they may provide a good option for patients who are not candidate for excimer laser correction.

With the rise and advancement of new technologies and techniques came a list of acronyms. From SMILE to LALEX to CLR and LALplus, the field of current vision correction treatments is vast. At Pacific Vision Institute, we have developed a series of continuing education workshops where we share practical advice for selection, education, and postoperative management of patients. **415-922-9500** Page 1 www.pacificvision.org

#### Laser-focused: a comprehensive guide to modern laser vision correction

Cornea is one of the most powerful refractive structures of the eye. Vision correction surgery began more than a century ago with procedures to modify corneal curvature. Initially, the corneal incisions were the only method to modify cornea. Starting in 1890's and peaking in the 70's and early 80's, corneal incisions were done to reduce myopia (radial keratotomy), astigmatism (astigmatic keratotomy), and (less successfully) hyperopia (hexagonal keratotomy). Radial keratotomy (RK) procedures were quickly replaced by excimer laser in the 90's. But astigmatic keratotomy (AK) is still being done today, mostly during cataract surgery. Surgical blade is still used in some cases, while in others, femtosecond laser is used. The femtosecond laser used in cataract surgery is typically different than the femtosecond lasers used to make a corneal flap in LASIK surgery or to create a corneal lenticle in SMILE surgery.

In the 1950's, another concept of corneal surgery was developed, called keratomileusis. Instead of making incisions perpendicular to the cornea, as in RK and AK, the incision was made parallel to the cornea. During this surgery, a corneal disc was created with a blade. This disc had no hinge to hold it to the rest of the cornea and it was called a cap. The cap was frozen and reshaped with a cryolathe to reduce its curvature, correcting myopia. It was then replaced on the cornea. Over the years, refinements in techniques and technologies allowed the cap to be hinged to the cornea and become the flap. The underlying stroma was initially reshaped with a blade. This procedure was called automated lamellar (=layers of the cornea) keratoplasty (=corneal remodeling) or ALK. At about the same time as we were doing ALK, excimer laser entered the field of vision correction. It was the single most defining moment in evolution of refractive surgery. The precision of excimer laser to reshape the cornea was obvious from the very first procedures that were performed.

Initially, the laser reshaping was done on the surface of the cornea, a procedure called Photorefractive Keratotomy, or PRK. PRK is widely performed today, with millions of patients having their vision corrected. Several years after PRK procedures began, a procedure called LASIK was invented. Laser Assisted In-Situ Keratomeleusis (LASIK) combined the corneal flap concept of ALK and corneal reshaping of PRK. Unlike PRK, corneal reshaping was performed on the corneal stroma, after the flap was lifted. The flap was repositioned on the cornea, allowing for rapid recovery of vision. LASIK was patented in 1989. Since then, more than 40 million LASIK procedures have been performed worldwide

#### **Evolution of LASIK/PRK**



The early years of laser vision correction focused on optimizing accuracy of correcting sphere and cylinder. The combination of improving laser parameters and surgeon-specific nomograms created a possibility of eliminating refractive error accurately. The 1990's were the years of **ACCURACY** optimization. The next milestone was converting from mechanical (blade) microkeratome to laser to create corneal flap. The laser to make the flap was different

than the excimer laser used to reshape the cornea. The flap laser is a femtosecond laser. This means that each laser pulse lasts 10<sup>-15</sup> seconds. Excimer laser pulse duration is 10<sup>-9</sup> seconds. When LASIK flap is performed with femtosecond laser, it is called All-laser LASIK (also known as femto LASIK or IntraLASIK). Procedure safety improved significantly when we started using laser to do LASIK flap. Pacific Vision Institute was the first clinic in San Francisco Bay Area to use the femtosecond laser technology and perform All-laser LASIK. Dr. Faktorovich's textbook *Femtodynamics: a Guide to Laser Settings and Procedure Techniques to Optimize Outcomes with Femtosecond Lasers*, was chosen as the top textbook for eye surgeons by the Editor-in-Chief of the



Editor-in-Chief of the *Cornea* journal (Figure 1). The most significant safety development in PRK surgery came about as we started using Mitomycin C during the procedure. It allowed us to perform PRK safely in patients even with moderate and high myopia and astigmatism. Other names for PRK are Epi-LASIK and LASEK. The early 2000's were the years of **SAFETY**.

Since then, major efforts and developments in both LASIK and PRK have been happening with discovery and development of **CUSTOMIZATION** to treat Higher Order Aberrations (HOAs). While refractive errors (Lower Order Aberrations, LOAs) may be similar among many people, each individual has a unique pattern of HOAs (Figure 2). To optimize day and nigh vision, both LOAs and HOAs need to be treated. Early attempts to treat HOAs were done with wavefront-guided LASIK and PRK. Turns out

there were limitations to this approach. Wavefront-guided treatments measured the aberrations of the entire eye, including the crystalline lens. When lens changes with age, the aberrations change

calculations of further measurements.

as well. Over the years, the focus shifted to treating HOAs unique to patients' corneas since corneas don't typically change with age. As a results, two new types of customized treatments were developed - wave-front-optimized and topography-guided (CONTOURAVision). With

Figure 2 Higher Order Aberations



Trefoil Higher Order Aberration

wavefront-optimized treatments, the surgeon guides the laser based on patient's corneal curvature. With CONTOURA Vision- guided treatment, 88,000 corneal data points are measured and the data is analyzed with AI-driven software to customize the treatment plan for the patient that eliminates refractive error and also treats HOA's (Figure 3). There are currently 3 types of CUSTOM LASIK or PRK - wavefront-guided, wavefront-optimized, and topography-guided (CONTOURA Vision). At Pacific Vision Institute, better than 20/20 vision is possible in a great majority of patients. The process of data gathering is extremely involved. PVI standard operating procedure for CONTOURA Vision LASIK and PRK is over 103 steps. Manifest refraction alone is a 15-step process that insures accurate

### Here are some of our eye doctors, their family, and tech leaders who had LASIK/PRK at Pacific Vision Institute



Today, there are 5 different femtosecond lasers used to create a corneal flap. There are also 6 different types of excimer lasers to reshape the cornea. Therefore, **30 different types of All-laser Custom LASIK** are possible and **6 different types of of Custom PRK**. Some lasers are better than others. It is, therefore, essential to understand the difference and determine if the most optimal technology is being used to treat the patient's refractive error and higher order aberrations.

	All-laser LASIK laser flap-makers used today (x5)								
	Femtosecond Laser	Femto LDV Z series (2nd gen)	WaveLight FS 200 Femtosecond Laser (1st gen)	VisuMax Femto- second System (SMILE laser)	Intralase FS 60 laser (4th gen)	iFS Advanced Femtosecond Laser (5th gen)			
	Manufacturer	Ziemer	Alcon	Zeiss	Johnson & Johnson	Johnson & Johnson			
	Consider- ations	<ul> <li>Decentration</li> <li>Difficult to fit into small lid apertures</li> <li>Bed rougher than with other lasers</li> </ul>	- Loss of suction	- Loss of suction - Decentration	- Bed rougher than with next gen laser	- Subconj heme			

CUSTOM LASIK excimer lasers used today (x6)									
Femtosecond Laser	WaveScan Wavefront™ StarS4 IR™	iDesign Advanced Wavescan™ StarS4 IR™	WaveLight® Allegretto Wave®	WaveLight® Allegretto Wave® Eye-Q	WaveLight® EX500	CONTOURA WaveLight® EX500			
Manufacturer	Johnson & John- son	Johnson & John- son	None (no support!)	Alcon	Alcon	Alcon			
# of aberration points targeted	200 (wavefront-guid- ed)	1,200 (wavefront- guided)	patient-spe- cific K's (wavefront-op- timized)	patient-specific K's (wave- front-optimized)	patient-spe- cific K's (wavefront-op- timized)	88,000 (topography-guided)			
Laser speed	6 Hz - 20 Hz	6 Hz - 20 Hz	200 Hz	400 Hz	500 Hz	500 Hz			
Eye tracker	60 Hz	60 Hz		200 Hz 6ms latency	1,050 Hz 2ms latency Cyclo com- pensation	1,050 Hz 2ms latency Cyclo compensation Iris Registration			
Additional names	CustomVue		PerfectPulse Technology®	PerfectPulse Technology®	PerfectPulse Technology®	PerfectPulse Technology®			

#### LALEX (Laser-Assisted Lenticule Extraction)



The third type of laser vision correction is commonly referred to as SMILE. The acronym stands for SMall Incision Lenticular Extraction. SMILE is a procedure performed specifically with a VisuMax 500 (Zeiss) laser - the 1st generation of femtosecond lasers designed to create two planes in the cornea and a small arcuate incision. A surgeon then manually dissects along both planes, creating a sliver of corneal tissue, called a lenticle. The surgeon extracts this lenticle through the small incision and then examines it to make sure all the pieces were removed. In her textbook, *Femtodynamics*, Dr. Faktorovich describes the lenticle extraction with the Zeiss femtosecond laser and provides tips on how to optimize the excision. Since SMILE was FDA-approved

eight years ago, additional laser technologies emerged. The acronyms to describe the procedures depend on the laser used to create corneal planes and the incision. When lenticular extraction is performed with the 2nd generation femtosecond laser, VisuMax 800 (Zeiss), it's called SMILE Pro. When Johnson & Johnson's latest femtosecond laser, ELITA, is used, the procedure is called SILK. Lenticular extraction done with Zeimer laser, is called CLEAR. Because the names of procedures vary depending on what laser is used, a new term emerged to describe all lenticular procedures, regardless of technology - LALEX, which stands for Laser Assisted Lenticular Extraction. LALEX done with Elita laser, i.e. SILK, is the most advanced. Its fastest pulse rate, low energy, and very close spot placement allows for the most atraumatic dissection and visual recovery faster than with other lasers. This laser is currently FDA-approved for LASIK flap creation. SILK procedure is under investigation. Preliminary results are promising. Regardless of the laser used, none of the lenticular procedures can be customized like LASIK and PRK. Only lower order aberrations, sphere and cylinder, can be corrected. The absence of ability to customize lenticular treatments means that quality of vision may not be as good as LASIK and PRK. The ability to achieve better than 20/20 vision may also not be as great as with LASIK and PRK. Some higher order aberrations refract as sphere or cylinder at the phoropter. Left untreated, they may present as undercorrection postoperatively. Further treatments with PRK may need to be performed to address the undercorrection.

Procedure Name	SMILE =ReLEx SMILE (SMall Incision Lenti- cule Extraction)	SMILE Pro	SILK (Smooth Incision Lenticle Keratomileusis)	CLEAR (Cornea Lenticle Extraction for Ad- vanced Refractive Correction)
Laser	Zeiss VisuMax 500	Zeiss VisuMax 800	J&J ELITA	Zeimer Z8
Pulse Rep Rate	500 kHz	2,000 kHz	10,000 kHz	Up to 20,000 kHz
Pulse Energy	150 nJ	150 nJ	< 50 nJ	100 nJ
Laser Spot Separation	4 microns	4 microns	1 microns	
Considerations	<ul> <li>no centration</li> <li>no cyclotorsion control</li> <li>loss of suction</li> <li>high energy</li> <li>no customization</li> </ul>	<ul> <li>loss of suction</li> <li>high energy</li> <li>no customization</li> </ul>	<ul> <li>Fast pulse rate, low energy, spots close together result in smooth lenticle with easy dis- section = faster visual recovery than SMILE</li> <li>no customization</li> </ul>	<ul> <li>minimal experience</li> <li>high energy</li> <li>no customization</li> </ul>

#### The power of the lens: a comprehensive guide to modern lens vision correction

The first intraocular lens was implanted by Sir Harold Ridley in 1949 to replace the extracted cataract lens. This lens implant ushered in the era of lens implant surgery which evolved along two paths - phakic IOLs and lens implants following extraction of crystalline lens. The advances in evolution of lens technology were aimed at improving the tolerability of the implants inside the eye and, in the case of lenses to correct aphakia, improving the range of vision.

Phakic IOLs were initially placed in the anterior chamber which led to complications and they were eventually abandoned. Posterior phakic IOLs were better tolerated and their development progressed rapidly. Currently used phakic IOL, called EVO

#### Who IS a good candidate for EVO ICL?

- Patients who 21 to 43 y.o. AND are not good candidates for LASIK/ PRK
  - Myopia > -12D
  - Cornea too thin or too flat for laser
  - Cornea too irregular for laser due to KCN (need to differentiate from EBMD with ETM!)
  - Large central corneal scar
  - Eyes are too dry, even after treatment
  - Systemic conditions that preclude LASIK/PRK MS, RA, etc BUT NOT bleeding disorders (vonW patient)
- Internal Anterior Chamber Depth at least 3.00 mm
- OK with glare
- Good for PRK but doesn't want healing time

#### Who IS a good candidate for RLE/CLR?

- 55+ y.o. hyperopes and 60+ y.o. myopes with PVD who are not candidates for LASIK/PRK
  - Cataracts (even mild)
  - Cornea too irregular for laser due to KCN (need to differentiate from EBMD with ETM!)
  - Cornea too thin or too flat for laser
  - Large central corneal scar
  - Eyes are too dry, even after treatment
  - Wants BOTH distance AND near vision AND doesn't like monovision AND has OSI is more than 1.5
  - Good for PRK but doesn't want the healing time

#### RLE (Refractive Lens Exchange) = CLR (Custom or Clear Lens Replacement)

- Monofocal
  - Basic
  - Toric
    - LAL (Light Adjustable Lens)
- Multifocal
  - Trifocal (Distance, interm, near) PanOptix, Tecnis MF
  - "EDOF" (Distance and intermediate) Vivity, Symfony = EDOF at 2 mm pupil, otherwise, bifocal
- Spherical Aberration IOL
  - Enhanced monofocal (Distance and mild ntermediate) Technis
    Eyhance
  - LAL+ (Distance and mild intermediate)
- Small Aperture (for aberrated corneas) IC-8 Apthera

ICL, is placed between the iris and the crystalline lens. It can be very effective in correcting refractive error, but since it is an intraocular procedure, risks such as endophthalmitis and cataracts need to be considered. Eventhough EVO ICL is approved for myopia between -3 and -20 diopters, the benefits may not outweigh the risks in lower myopes who are easily correctible with laser vision correction that can treat both lower and higher order aberrations. In higher myopes, however, the benefits of EVO ICL may outweigh the risks, especially when patients are not candidates for laser vision correction. EVO ICL is approved for patients ages 21 to 45 years old. We do tend to recommend it to patients up to 43 years old, however, to reduce the risk to crystalline lens.

IOLs to correct aphakia are used in patients underging both cataract surgery and Refractive Lens Exchange (RLE). RLE is also referred to as CLR (Custom or Clear Lens Replacement). This type of surgery can be considered in presbyopic patients. Not all presbyopic patients are excellent candidates for RLE/CLR. Younger patients who are high myopes are at risk for retinal detachment. In a recent review "Pseudophakic retinal detachment: a ticking time bomb" published in March 2023 issue of Journal of Refractive Surgery, the authors emphasize the risk of retinal detachment in myopes younger than 60 years old with axial length greater than 25 mm increases by 12 fold. Patients need to be fully aware of the risk before considering RLE/CLR.

There are 4 types of IOLs used in RLE/CLR - monofocal, multifocal, spherical aberration IOLs, and small aperture IOLs. Light Adjustable Lens (LAL) is a monofocal lens. Near vision can be achieved with a monovision postoperative target. LAL+ has spherical aberration, allowing for some intermediate vision. Patients who are not candidates for multifocal lenses are not candidates for LAL+. Multifocal IOLs can work well in patients with normal ocular health. Dysphotopsias may be inevitable and need to be considered.



 Dr. Faktorovich is selected for the San Francisco Magazine Top Doctors 2024 list. The doctors chosen for the list were nominated by their peers when asked a question of whom they would chose for themselves or their family members.



- Castle Connolly selects Dr. Faktorovich for their 2024 Top Ophthalmologists list. The list represents top 7% of 63,000 board-certified physicians in all specialties in the US
- The research team at Pacific Vision Institute collaborated with the team in Canada to publish a peer-reviewed article in the Journal of Cataract and Refractive Surgery summarizing current ocular analgesics. "Topical

analgesics for acute corneal pain: current options and emerging therapeutics" reviews the latest evidence on efficacy of topical non steroidal anti-inflammatory drugs, anticholinergic agents, and anesthetics. New analgesic avenues are described, including topical endocannabinoid system modulators.



https://pubmed.ncbi.nlm.nih.gov/37232414/

**EnVision Summit Ophthalmology & Optometry** 

- Dr. Faktorovich was an invited guest speaker at the EnVision Summit in Puerto Rico, an annual conference created by physicians to support and empower ophthalmic and optometric leaders in an innovative format for continuing medical education. The presentation "Strategies for successful prevention and management of epithelial complications to optimize outcomes of LASIK and PRK" focused on novel diagnostics and topical treatment options.
- Pacific Vision Institute was chosen as the Best LASIK Eye Surgeon in San Francisco by the Vision Center - an independent organization credentialing surgical subspecialties



- Dr. Faktorovich Interviewed by CBS News Chanel 5 KPIX About 2024 Eclipse Viewing Safety.
- Pacific Vision Institute featured in a WebMD article about variables that go into calculating the correct power of an implant for cataract surgery in oder to ensure good vision after surgery



- Pacific Vision Institute featured in US News and World Report article on optimal vitamins to improve ocular surface and tear film.
- Dr. Faktorovich interviewed on 94.1 KPFA on vision health as it relates to different stages of life. She discussed myopia, refractive surgery, cataract surgery and other advanced technologies to help patients



phMI)

### Ophthalmologist

observed to have a wide range of

- The research team at Pacific Vision Institute and Dr. Faktorovich publish an article at The Ophthalmologist on endocannabinoid system modulation and its potential therapeutic benefits for ocular comfort
- · Forbes interviews Dr. Faktorovich on LASIK for Astigmatism

Forbes HEALTH LASIK For Astigmatism

#### **Ophthalmology** Times CUTTING-EDGE ADVANCEMENTS

cal Cannabinoids and Ocular Pain Relief cannabinoid system (ECS) modulation has been

• Ophthalmology Times interviews Dr. Faktorovich on PVI-developed anti-inflammatory protocol to improve epithelial health after PRK



# **New Technology Corner**



At Pacific Vision Institute, we had an incredible opportunity to conduct research with the newest OCT. Optovue Solix OCT (Visionix) is a game-changing diagnostic technology, combining the widest range of corneal and posterior segment measurements. It is the only device available today that measures corneal epithelial thickness within the 10 mm optical zone, allowing diagnosis of subtle findings in corneal periphery. It may also potentially replace corneal tomography as a tool to measure both anterior and posterior corneal curvature using a single device vs. multiple devices. Other potential advantages of using a single device could be a convenience of AI applications to evaluate multimodal imaging data. Subtle abnormalities in corneal shape, thickness, and epithelial thickness can be assessed together to determine whether corneas are healthy or not.



# **Refractive Advisor**

### Q: How soon can I travel after my LASIK/PRK?

A: You can travel as soon as the next day after LASIK, after you see the eye doctor for postoperative Day 1 visit. You can also travel the next day after PRK, but you will need to have the bandage contact lens



removed 1 week after the procedure. We typically advise PRK patients to wait until after the lens is removed to travel. Air travel is fine but make sure to use Refresh Plus and Celluvisc on the plane, as the air tends to be dry on the plane.



In Japan...wearing those sunglasses!!! Eyes feeling great Thank you Dr!

### Q: How soon can I resume my usual sports activities after LASIK/PRK?

A: We recommend you don't get water or sweat in your eyes for a week after LASIK or PRK. If you run, cycle, rock climb, weight lift or do other activities where you sweat, you can resume as soon as the next day, but make sure no sweat gets in your eyes. Swimming can be resumed one week after. Surfing, two weeks after. Yoga can resume as soon as the next day, but wait a week to resume hot yoga.

### OPTOMETRIC CONTINUING EDUCATION & EVENTS

<u>September 18, 2024:</u> Marin Seminar "Demystifying Today's Refractive Surgery Options"

September 19, 2024: East Bay Seminar "Demystifying Today's Refractive Surgery Options

April, 2025: 19th Annual San Francisco Cornea, Cataract, and Refractive Surgery Symposium

**Ongoing:** Live Surgery Observation for OD Staff (includes breakfast) - please contact us at comanagement@pacificvision.org to schedule the date and time for your staff to attend and learn

**Ongoing:** Lunch-and-Learn Education for OD Staff at your office (includes lunch provided by Pacific Vision Institute) - please contact us at comanagement@pacificvision.org to schedule the date and time for this fun and educational event for your office staff.



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