



In 1990-1995 the patent related to LASIK and PRK was given to US companies,

as a consequence, all previous corneal refractive techniques became obsolete, and those techniques became the top elective surgeries in the United States.



I have started practicing the technique in the early 2000's, another decade I got my own device, so I have records of thousands of eyes subjected to the technique,

From which I can learn many lessons and correct beliefs and practices for myself before giving advice to the others.



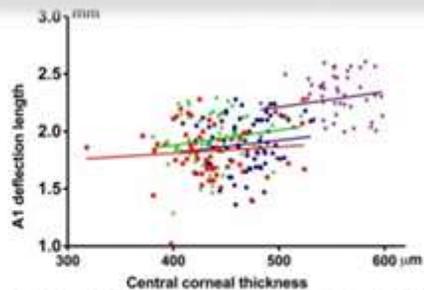
Corneal biomechanics are altered with regard to corneal hysteresis and corneal resistant factor.

A study performed in 2014 by Pedersen et al concluded that flap based LASIK, ReLEx flex and flap free ReLex SMILE all result in similar reduction in corneal biomechanics.



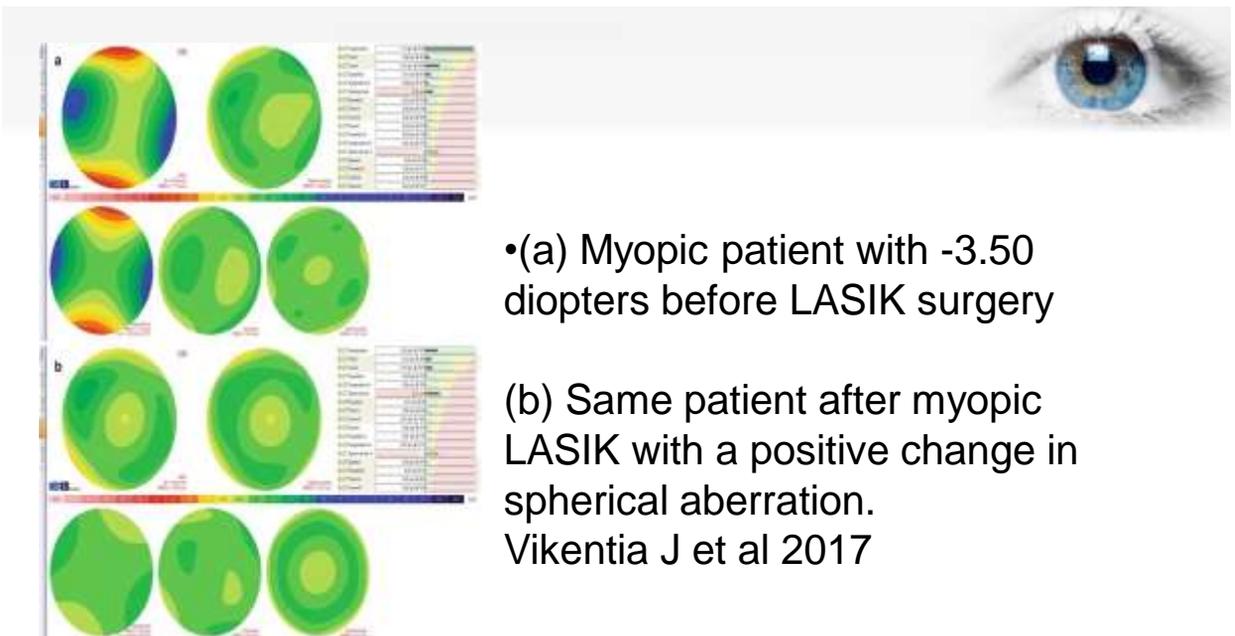
ORA parameters				
Parameters	Estimated Marginal Mean $\pm$ SE			
	LASIK n=35	ReLEx flex n=31	ReLEx smile n=29	Control n=31
CH (mmHg)	8.58 $\pm$ 0.15	8.48 $\pm$ 0.18	8.56 $\pm$ 0.19	9.70 $\pm$ 0.27
CRF (mmHg)	7.12 $\pm$ 0.18	7.00 $\pm$ 0.22	7.12 $\pm$ 0.23	8.5 $\pm$ 0.33

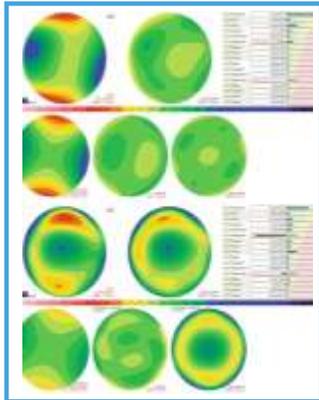
Estimated marginal means are evaluated at the following values: Age at examination 36.7 years, CCT 473  $\mu$ m, IOPcc 13.0 mmHg



A1 deflection length as a function of CCT: Blue: LASIK, Red: ReLEx flex, Green: ReLEx smile, Purple: Control group

- Patients with high errors are more exposed to post-operative problems than other candidates, they complain of optical disturbance.
- The optical disturbance are secondary to increase in high order aberration after refractive surgery, the greater the refractive error, the greater the induction of corneal aberration.
- Most commonly induced aberrations are spherical aberration and coma.
- Even the latest technology in lasers induces a significant amount of aberrations( *Vikentia J et al 2017*).

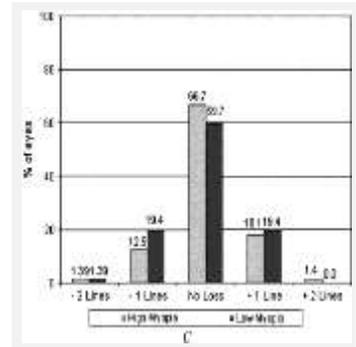
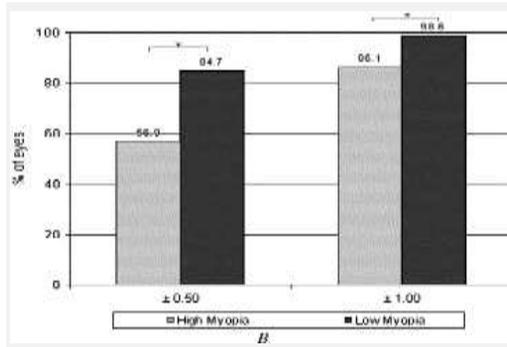
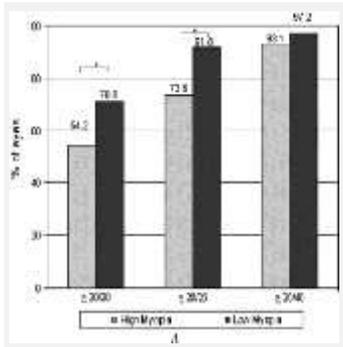




Patient with hyperopia of +6.00 diopters before LASIK surgery  
 Same patient as after hyperopic LASIK, there is a negative change in spherical aberration  
***Vikentia J et al 2017***

### Outcomes in extreme refractive errors

- Laser in situ keratomileusis for high myopia efficacy and predictability was lower than for low myopia
- Several studies have compared the outcomes of LASIK between patients with high myopia and patients with low myopia. Lindstrom et al report that fewer patients with high myopia than patients with low myopia had an uncorrected visual acuity (UCVA) better than 20/25 and 20/40 at 1 month (***Takashi Kojima et al 2008***).



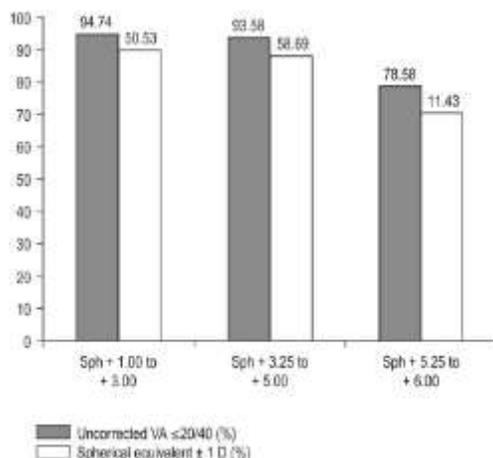
Efficacy, predictability, and safety parameters of high versus low myopia (72 matched eyes).  
 A :Postoperative UCVA.  
 B :Postoperative SE.  
 C : Lines of BSCVA Snellen lines.  
 ( Takashi Kojima et al 2008)



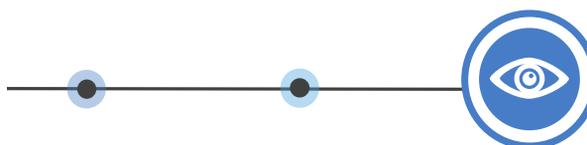
-Following approval by the US Food and Drug Administration, many surgeons attempted correction of hyperopia up to 6 diopters with LASIK or PRK.

-In a representative study, 50% of eyes above 5 diopters lost two lines of best spectacle-corrected visual acuity.

-Other studies reported high rates of two-line loss of BSCVA when correcting more than 4 diopters of hyperopia with LASIK.



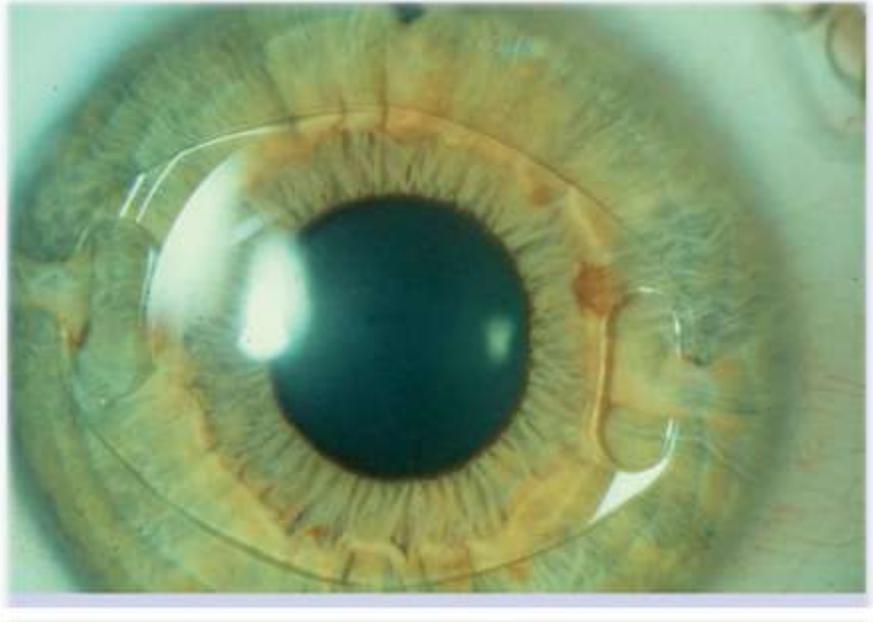
LASIK for hyperopia. Uncorrected visual acuity (VA) better or equal to 20/40 (%) and final spherical equivalent  $\pm 1$  D (%). (Wilson et al)



### Phakic IOLs as a safe substitute for extreme refractive errors

-Phakic IOLs are alternatives to LASIK and PRK eye surgery for correcting moderate to severe myopia and in some cases they produce better and more predictable vision outcomes than laser refractive surgery.

-They may be placed in the posterior chamber “Visian ICL” or anterior chamber “Verisyse”



#### Phakic IOLs as a safe substitute for extreme refractive errors



A study performed by Francois J Malecaze et al to compare refractive performance and safety of laser in situ keratomileusis (LASIK and Artisan phakic intraocular lens (PIOL) for moderately high myopia concluded that :-

LASIK and Artisan phakic intraocular lenses seemed to produce a similar predictability ,but the best-corrected visual acuity and subjective evaluation of quality of vision were better for Artisan.

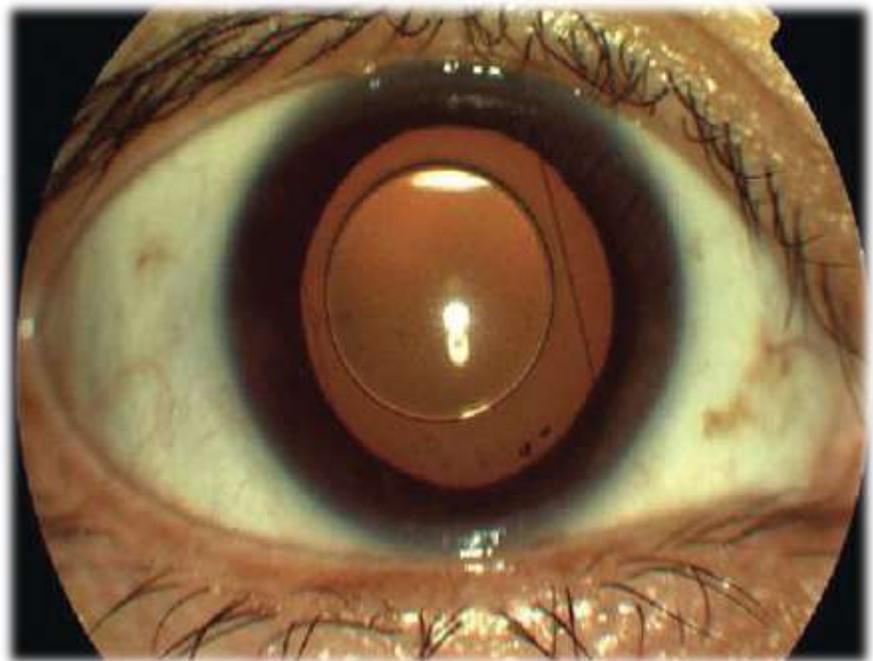
### Phakic IOLs as a safe substitute for extreme refractive errors



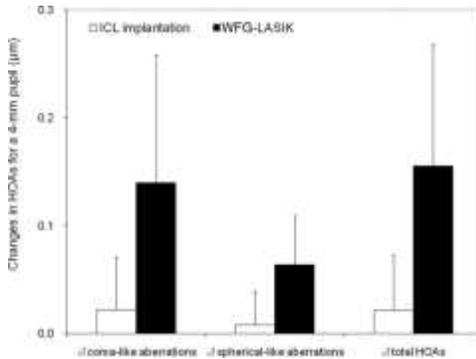
Another study conducted by Akihito Igarashi et al to compare postoperative visual function after ICL Implantation and after wavefront-guided laser in situ keratotomy (WFG-LASIK) in eyes with high myopia concluded that :-

ICL implantation induces significantly fewer ocular high order aberrations than WFG-LASIK. Moreover, contrast sensitivity was improved significantly after ICL implantation, but deteriorated after WFG-LASIK in eyes with high myopia.

Thus, in the correction of high myopia, ICL implantation seems to be superior in visual performance to WFG-LASIK, suggesting that it may be a better surgical option for the treatment of such eyes.



A summary of the study is illustrated in the following graphs .

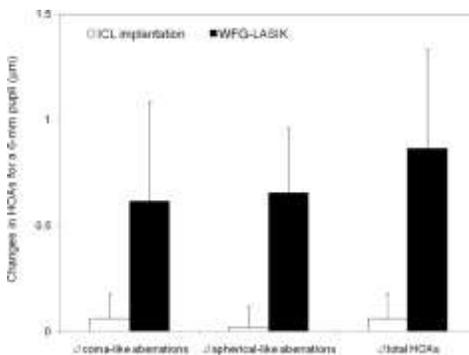


Bar graph showing the inductions of coma-like aberrations, spherical-like aberrations, and total higher-order aberrations (HOA) after implantable collamer lens (ICL)

implantation and after wavefront-guided laser in situ keratomileusis (WFG-LASIK) for a 4-mm pupil.

The coma-like aberrations, spherical-like aberrations, and total HOAs that were induced were significantly fewer after ICL implantation than after WFG-LASIK ( $P < .001$ , Mann–Whitney U test).

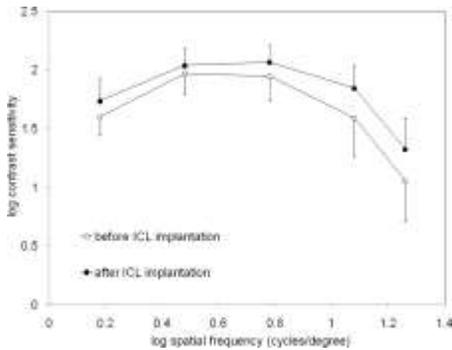
A summary of the study is illustrated in the following graphs .



Bar graph showing the inductions of coma-like aberrations, spherical-like aberrations, and total HOAs after ICL implantation and after WFG-LASIK for a 6-mm pupil.

The coma-like aberrations, spherical-like aberrations, and total HOAs that were induced were significantly fewer after ICL implantation than after WFG-LASIK ( $P < .001$ , Mann–Whitney U test).

A summary of the study is illustrated in the following graphs .



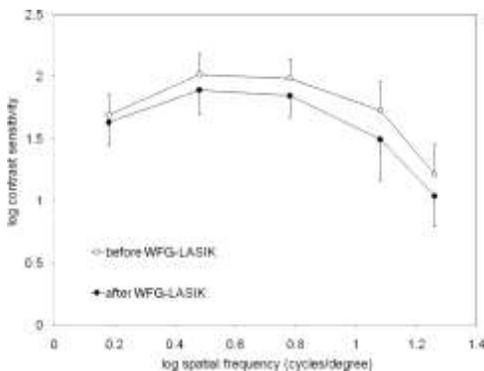
Graph showing the contrast sensitivity (CS) at 5 spatial frequencies before and after ICL implantation.

ICL implantation significantly increased the area under log CS function ( $P < .001$ , Wilcoxon signed-rank test).

There was also a significant increase in CS at 4 of 5 spatial frequencies (but not at 3 cycles/degree) after ICL implantation.

Bar represents standard deviation (SD)

A summary of the study is illustrated in the following graphs .



Graph showing the CS at 5 spatial frequencies before and after WFG-LASIK. WFG-LASIK significantly decreased the area under log CS Function.

( $P < .001$ , Wilcoxon signed-rank test).

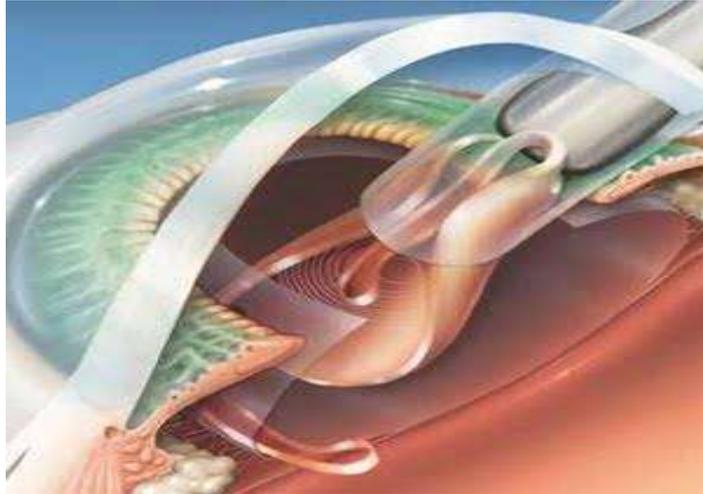
There was also a significant decrease in CS at 4 of 5 spatial frequencies

(but not at 1.5 cycles/degree)

after WFG-LASIK. Bar represents SD.



### Early cataract surgery or refractive lens exchange for high refractive errors



### Early cataract surgery or refractive lens exchange for high refractive errors

Unlike the corneal procedures that have been discussed, refractive lens exchange (RLE) is a surgical option that can correct refractive errors by removing and replacing the crystalline lens.

In essence, RLE is cataract surgery without a visually significant cataract, which is the clouding or opacification of the natural lens.

RLE is a viable option for high myopes and hyperopes, where laser vision correction is not an option, and for presbyopia.



### Early cataract surgery or refractive lens exchange for high refractive errors

There's no shame in performing early refractive lens exchange when the surgeon thinks that he exposes his patient to corneal hazards if he performed corneal refractive surgery, and when it's too late to implant a phakic IOL " people above 40's and 50's even without nuclear sclerosis, and ask for refractive surgery with extreme refractive errors".

Still the risk of post-operative endophthalmitis (0.05% -0.1%) , retinal detachment and post-cataract posterior capsular opacity, are factors that make RLE amore risky procedure, at least from a theoretical stand point.

## To sum up briefly



### In answer to the question : what I'm doing differently this year ?

-Actually I didn't adopt any new technology or technique regarding refractive surgery, but I'm trying to develop a new criteria – for myself than anyone else- for selection of the proper procedure for each case, no matter it was a laser assisted surgery, Phakic IOL, or refractive lens exchange, what I care about now is patient safety and satisfaction.

-I don't want fascination by technology- that's really charming- to take me far away from the genuine medical and ethical standards.



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**Thank you**