

# REDISCOVERING FLACS: CONFESSIONS OF A FORMER DISBELIEVER

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Milwaukee, WI



John Vukich

I consult and have done research for:

- ALCON
- B+L
- Glaukos
- Jellisee
- Johnson & Johnson Vision
- LensAR
- Optical Express
- Praxis
- RxSight
- STAAR Surgical



# THE EVOLUTION of FLACS



# What were my concerns with FLACS?

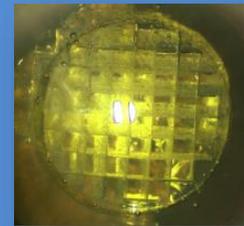
Why I did not adopt this

- Solving a “problem” that I do not have
- Inefficient time use
- Cost and ROI

# What changed my mind 15 years later?

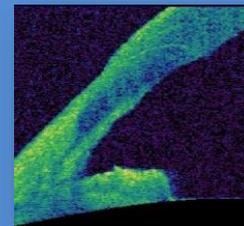
The problems I still do not have

Lens Fragmentation



Not a driver for me

Cataract Incision



Not a driver for me

# What changed my mind 15 years later

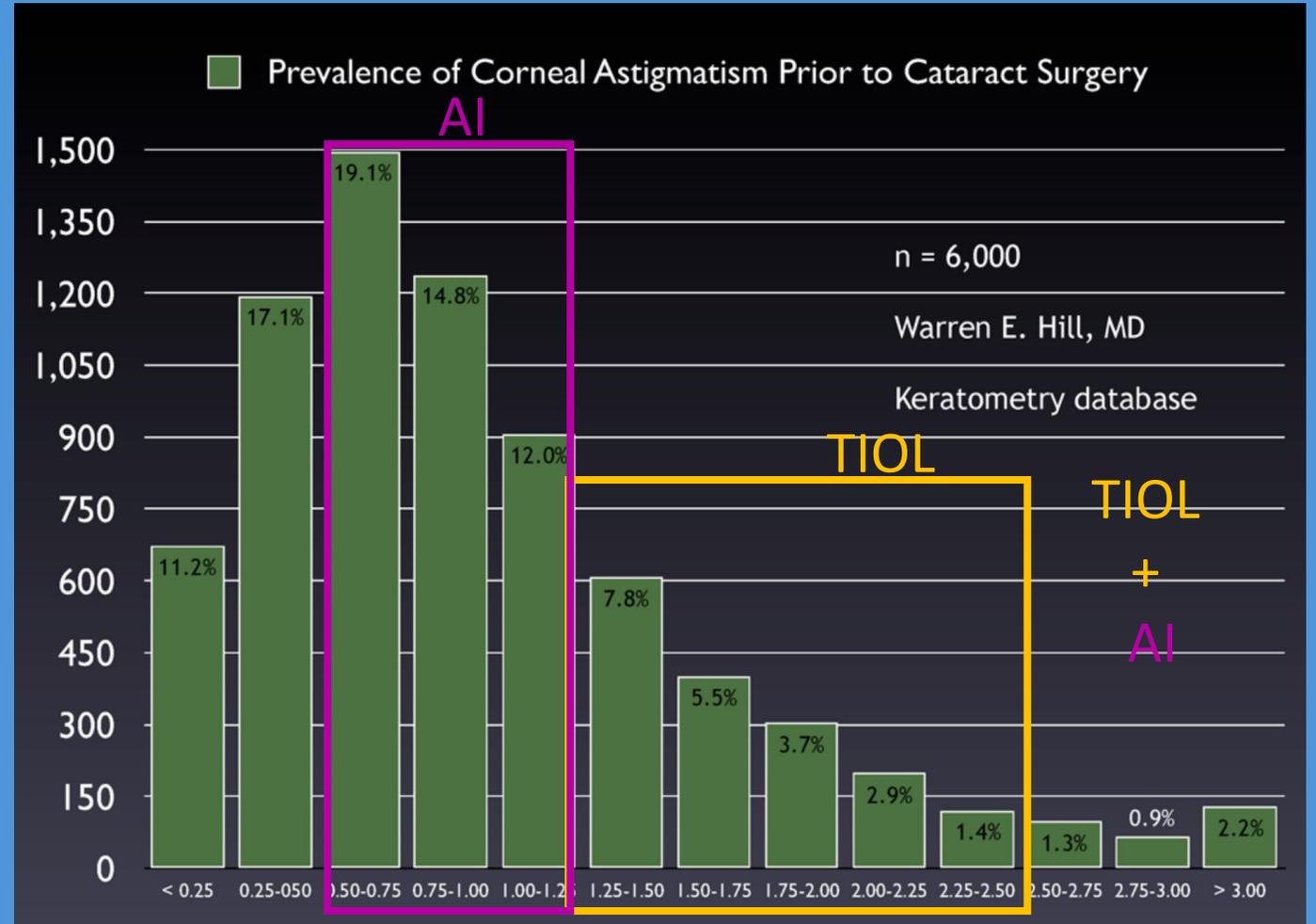
Astigmatic Correction  
1.25D or less



This changed my mind  
about FLACS

# Prevalence of Corneal Astigmatism

- 71.7% of patients have corneal astigmatism  $>0.5D$
- 45.9% of patients have between 0.5D-1.25D and can benefit from femto AIs
- 3.2% of patients need a toric IOL + additional astigmatism treatment
- Almost 50% of patients can benefit from femto arcuate incisions alone or in combo with TIOL
- 22.6% of patients can benefit from a TIOL alone



# Patient Satisfaction and Residual Astigmatism

- 17,152 eyes; multivariate analysis
- Compared with eyes with 0.00 diopter (D) residual astigmatism,
- in eyes with 0.25 to 0.50 D residual astigmatism the odds of not achieving 20/20 vision increased by a factor of 1.7 and 1.9 ( $P < .0001$ ) in monofocal and multifocal IOLs, respectively

## Effect of residual astigmatism on uncorrected visual acuity and patient satisfaction in pseudophakic patients

Steven C. Schallhorn, MD, Keith A. Hettinger, MS, Martina Pelouskova, MSc, David Teenan, MD, Jan A. Venter, MD, Stephen J. Hannan, OD, Julie M. Schallhorn, MD

**Purpose:** To evaluate the effect of residual astigmatism on postoperative visual acuity and satisfaction after intracocular lens (IOL) surgery.

**Setting:** Private practice, United Kingdom.

**Design:** Retrospective case series.

**Methods:** Postoperative data of patients who had previously undergone refractive lens exchange or cataract surgery were used in a multivariate regression model to assess the effect of residual astigmatism on 3 months postoperative monocular uncorrected distance visual acuity (UDVA) and patient satisfaction. The analysis was based on residual refraction in the dominant eye of each patient. Odds ratios were calculated to demonstrate the effect of increasing residual astigmatism on UDVA and satisfaction with separate calculations for monofocal and multifocal IOLs.

**Results:** Three months postoperative outcomes of 17 152 dominant eyes were used in multivariate regression analysis. Compared with eyes with 0.00 diopter (D) residual astigmatism, the odds of not

achieving 20/20 vision in eyes with 0.25 to 0.50 D residual astigmatism increased by a factor of 1.7 and 1.9 ( $P < .0001$ ) in monofocal and multifocal IOLs, respectively. For the residual astigmatism 0.75 to 1.00 D, the odds ratio for not achieving 20/20 vision compared with eyes with no astigmatism was 6.1 for monofocal and 6.5 for multifocal IOLs ( $P < .0001$ ). The effect of residual astigmatism on satisfaction was more evident at the 0.75 to 1.00 D level, where the odds of not being satisfied with vision increased by a factor of 2.0 and 1.5 in patients with monofocal and multifocal IOLs, respectively ( $P < .0001$ ). The orientation of astigmatism was not a significant predictor in multivariate analysis.

**Conclusions:** Multivariate analysis in a large population of patients demonstrated that low levels of residual astigmatism can degrade visual acuity. Corneal astigmatism of 0.50 D or greater should be included in surgical planning.

*J Cataract Refract Surg* 2021; 47:981-986 Copyright © 2020 Published by Wolters Kluwer on behalf of ASCRS and ESCRS

Preexisting corneal astigmatism has a high prevalence in intracocular lens (IOL) surgery candidates, and its management is an important part of surgical planning.<sup>1,2</sup> The accurate determination of the magnitude and orientation of astigmatism is the first step toward surgical success.<sup>3</sup> Several technological advances have been made in this respect in recent years, including the increasing role of posterior astigmatism in surgical planning.<sup>4-6</sup> In addition, the intraoperative management of astigmatism with the positioning of corneal incision, various incisional techniques, or the use of toric IOLs have shown clear benefits in astigmatism reduction among IOL surgery candidates.<sup>7</sup>

Residual astigmatism after intraocular surgery can have an adverse effect on patient visual acuity and satisfaction.<sup>8-11</sup> However, there is no clear consensus on minimum astigmatism that should be addressed during IOL surgery. The

minimum magnitude of postoperative astigmatism that negatively affects patient's visual acuity, especially in pseudophakic patients with no accommodation, is also unclear. It has been postulated that reducing astigmatism to 0.50 diopters (D) or less is the main goal of intraocular surgery.<sup>12</sup> However, there are no large-sample studies with sufficient statistical power to investigate the independent effect of low amounts of astigmatism on the outcomes of pseudophakic patients. In this study, we evaluated the effect of residual astigmatism on postoperative visual acuity and patient satisfaction in a large cohort of patients undergoing refractive lens exchange or cataract surgery.

### METHODS

This retrospective study evaluated patients who had previously undergone refractive lens exchange or cataract surgery at Optical Express, United Kingdom. The study was deemed exempt from

Submitted: September 20, 2020 | Final revision submitted: December 10, 2020 | Accepted: December 14, 2020

From the Department of Ophthalmology, University of California, San Francisco, San Francisco, California (S.C. Schallhorn, J.M. Schallhorn); Optical Express, Glasgow, United Kingdom (S.C. Schallhorn, Hettinger, Pelouskova, Teenan, Venter, Hannan); Carl Zeiss Meditec, Inc., Dublin, California (S.C. Schallhorn); P.J. Proctor Foundation, University of California, San Francisco, San Francisco, California (J.M. Schallhorn).

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0885-3309S - see frontmatter  
https://doi.org/10.1097/jcrs.0000000000000581

# Patient Satisfaction and Residual Astigmatism

- 0.75 to 1.00 D effect of residual astigmatism on satisfaction was more evident
- Odds of not being satisfied increased by a factor of 2.0 and 1.5 in patients with monofocal and multifocal IOLs, respectively ( $P < .0001$ )

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0885-3305 - see frontmatter  
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**METHODS**

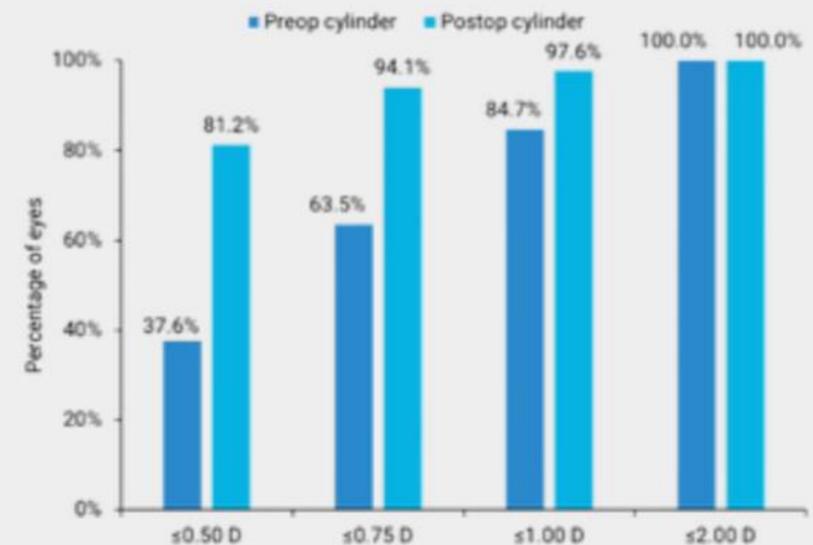
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# Arcuate incisions data

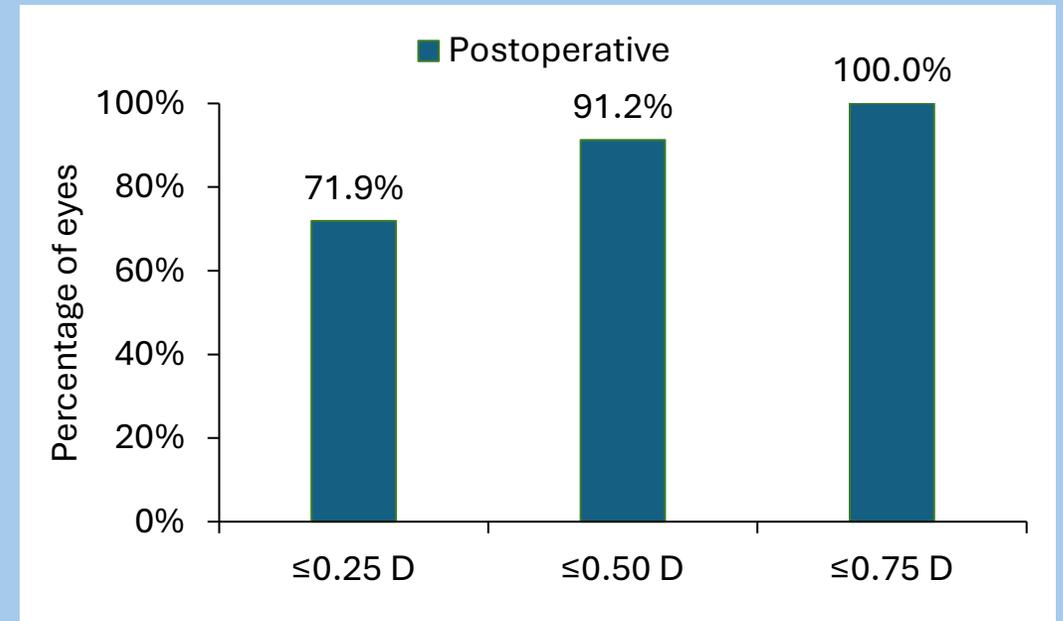
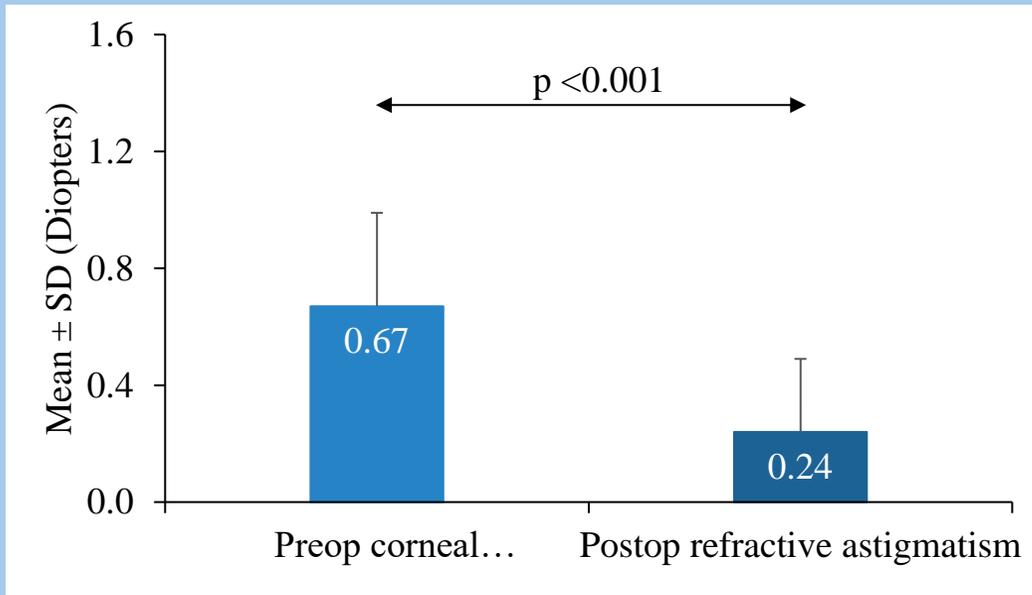
An evaluation of the effectiveness of beveled arcuate incisions during femtosecond laser assisted cataract surgery on postoperative visual outcomes.

- 81% of eyes achieved residual astigmatism of  $\leq 0.50D$  at 3 months postop
- 97.6% of eyes achieved UDVA of 20/30 or better



# Arcuate Incisions: Accuracy

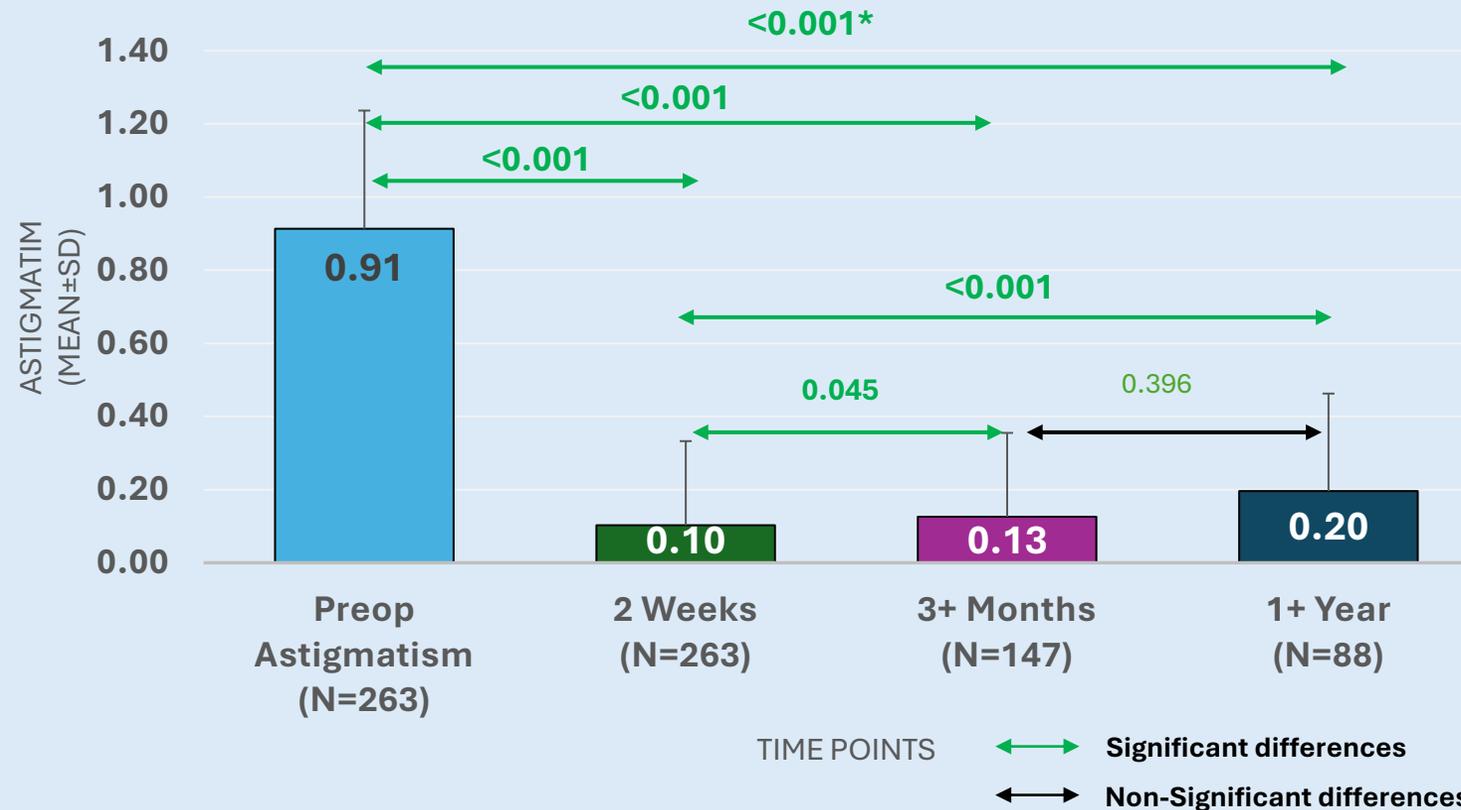
## Preop corneal vs postop refractive astigmatism



With a statistically significant reduction in mean corneal astigmatism, 91% of eyes achieved a refractive cylinder within 0.50 D postoperatively.

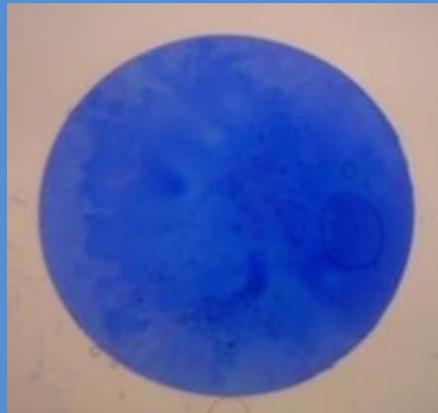
# Arcuate Incisions: Stability

- Mean Preoperative Corneal Astigmatism: 0.92 D
- Mean Residual Refractive Astigmatism: 0.20 D
- Astigmatism decreased significantly postoperatively ( $p < 0.001$ )
- Astigmatism remained stable from 3 months to 1 year



# What about higher levels of astigmatism for toric IOLs?

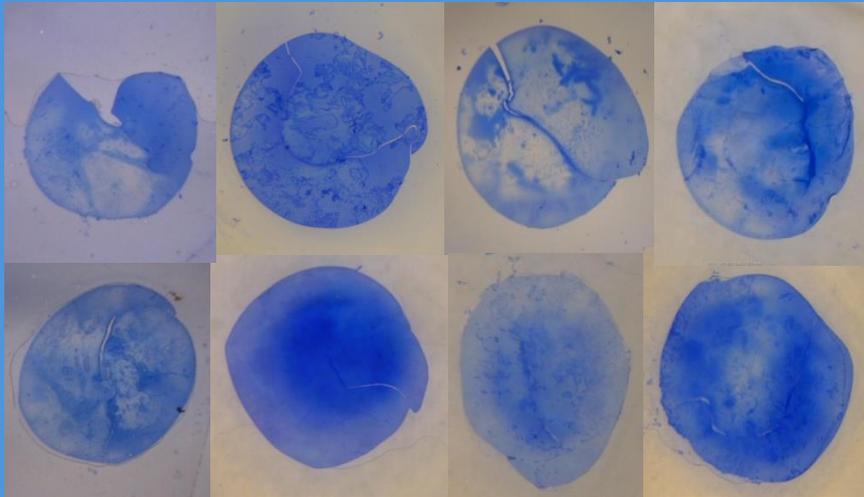
Capsulotomy



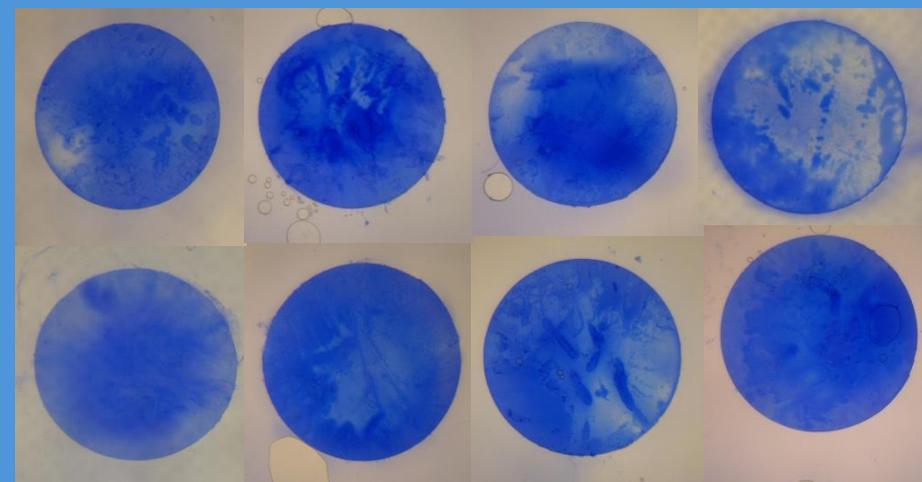
Consistent shape

# Comparison of Manual and fs LASER

	Manual Results	Laser Results
Target	5.0mm	4.6mm
Deviation from intended diameter (Mean $\pm$ SD)	329 $\mu$ m $\pm$ 250 $\mu$ m	27 $\mu$ m $\pm$ 25 $\mu$ m
Circularity (1=perfect circle)	0.765 $\pm$ 0.148	0.942 $\pm$ 0.040



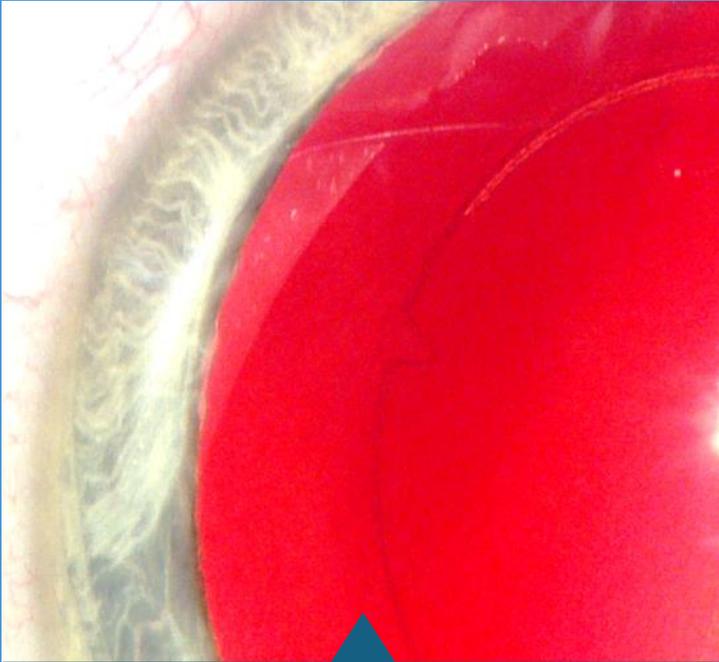
Manual



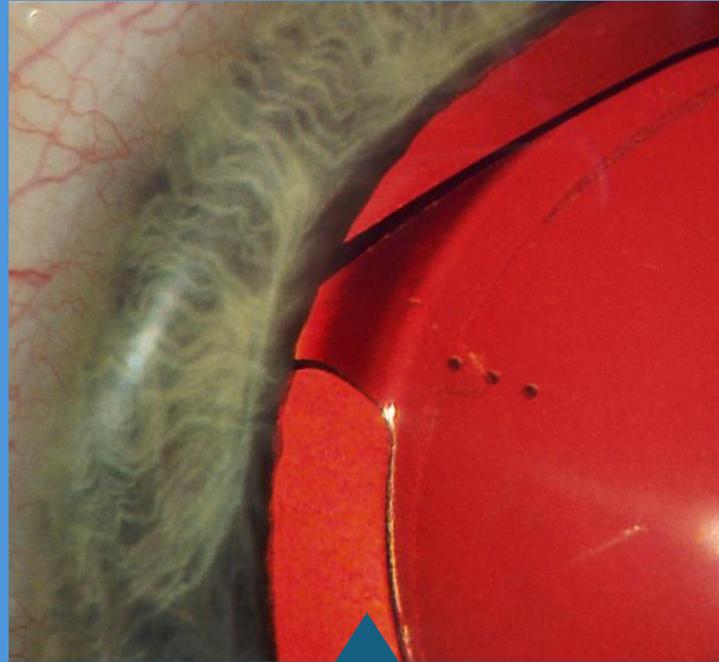
Laser

# Toric IOL alignment was a tipping point for me

Capsular Marks Easily Identified for IOL Alignment



**APHAKIC**



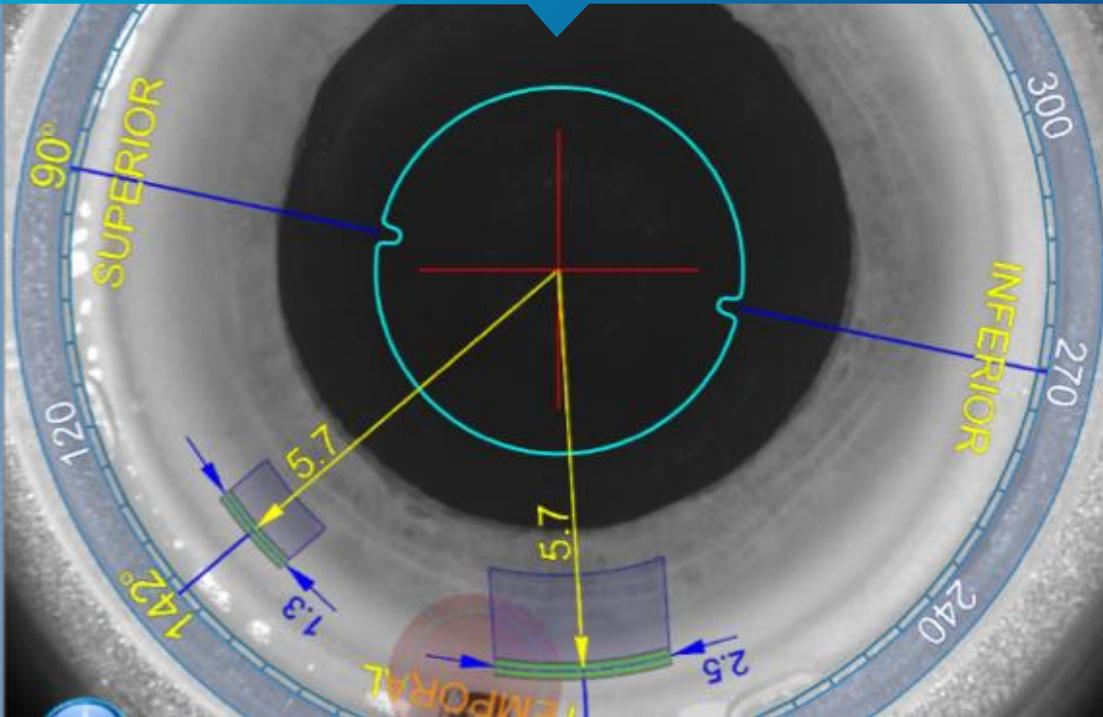
**PHAKIC**



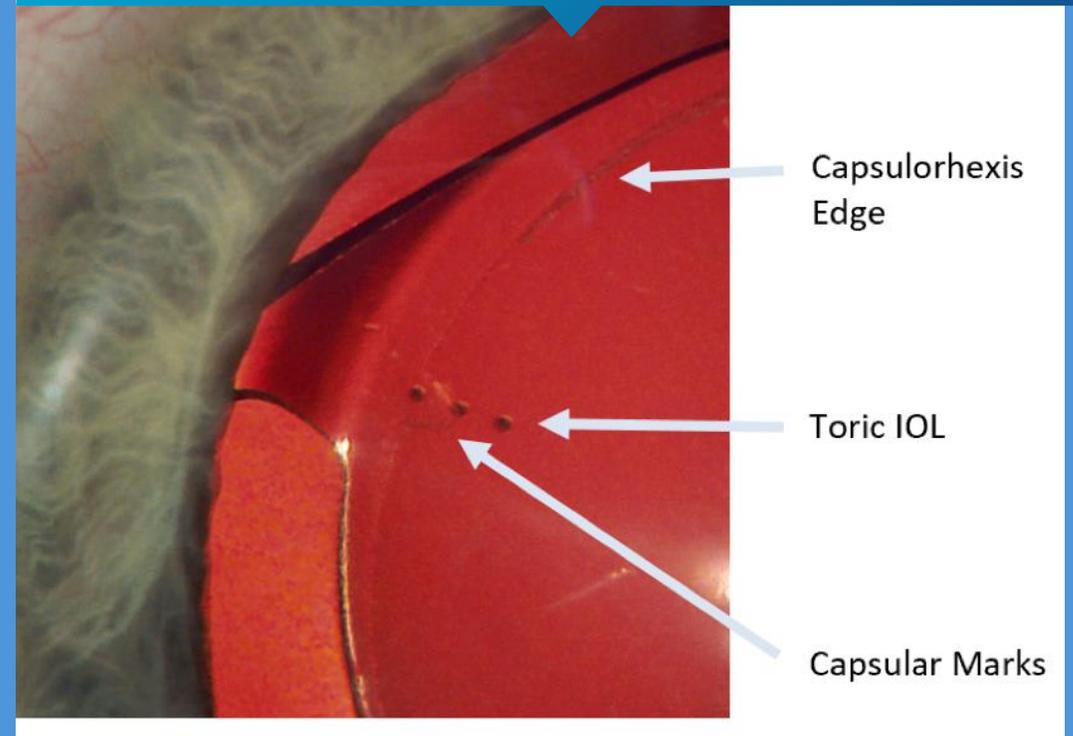
**PO DAY 1**

# Refractive Capsulorhexis and Toric IOL Alignment

Creates a pair of small tabs on the capsular rim guided by iris registration to identify the intended axis



These small tabs assist surgeons in accurately aligning toric IOL marks along the predefined axis



# Refractive Capsulorhexis CLINICAL SIGNIFICANCE

## Iris Registration Steep Axis Marks

### Iris Registration Capsulotomy Marking Versus Manual Marking for Toric Intraocular Lens Alignment in Cataract Surgery



QINGZHONG CHEN AND GUANGBIN ZHANG

• **PURPOSE:** To compare the accuracy of toric intraocular lens (IOL) alignment and visual outcomes using femtosecond laser-assisted capsulotomy marking (CM) versus conventional slit lamp–assisted manual marking (MM).

• **DESIGN:** Prospective cohort study.

• **METHODS:** A total of 57 patients who required cataract surgery and toric IOL implantation (Acrysof SN6AT3-T8) were assigned to the CM group (26 eyes) or the MM group (31 eyes). Uncorrected distant visual acuity (UCDVA), best-corrected distant visual acuity (BCDVA), residual astigmatism (RA), IOL misalignment, and modulation transfer function (area ratio [AR] value) were measured 1 and 3 months after surgery.

• **RESULTS:** Postoperative UCDVA (logarithm of minimal angle of resolution [logMAR]) was significantly lower in the CM group than that in the MM group ( $P < .05$ ). Postoperative RA and IOL misalignment were significantly lower in the CM group than that in the MM group (both  $P < .05$ ). No significant difference between the groups was observed for BCDVA or AR value (both  $P > .05$ ). UCDVA (logMAR) was positively correlated with RA ( $r = 0.339$ ;  $P < .05$ ) and IOL misalignment ( $r = 0.317$ ;  $P < .05$ ) and negatively correlated with the AR value ( $r = -0.272$ ;  $P < .05$ ); RA was positively correlated with IOL misalignment ( $r = 0.405$ ;  $P < .05$ ).

• **CONCLUSIONS:** The accuracy of the axis alignment was significantly higher in the CM group, which resulted in lower residual astigmatism and better visual outcomes. (*Am J Ophthalmol* 2021;221:97–104. © 2020 Elsevier Inc. All rights reserved.)

IT IS COMMON KNOWLEDGE THAT CATARACT SURGERY has gradually transformed from traditional restorative surgery to refractive surgery; with modern techniques, expectations regarding refractive outcomes continue to in-

crease. The correction of pre-existing corneal astigmatism at the time of cataract surgery results in better postoperative visual outcomes that can lead to higher satisfaction with vision and minimize postoperative spectacle dependence, compared with astigmatism correction with postoperative vision correction.<sup>1</sup> The major techniques for the correction of pre-existing corneal astigmatism during cataract surgery are limbal relaxing incisions on the steep meridian, astigmatic keratotomy, and toric intraocular lens (IOL) implantation. Among these techniques, toric IOL implantation appears to be safe and effective, indicating good predictability and stability as a correction of high range of pre-existing corneal astigmatism during cataract surgery.<sup>2</sup> Clinical evidence suggests that with each degree of toric IOL misalignment, there is approximately a 3.3% loss of astigmatic correction; an error of 30° to the intended meridian results in a complete loss of the effect.<sup>3</sup> Accurate alignment of toric IOLs is essential to achieving effective astigmatism correction and satisfactory postoperative outcomes.

To ensure high accuracy, it is important that toric IOLs have a precise axial position, which, in turn, depends on exact corneal marking. Several methods have been described to determine the best toric IOL position marking. A classic (and common) method is based on manual markers, which could be done by slit lamp–assisted marking with a horizontal slit beam, a pendular marker, and a nonpendular marker. However, the method has a risk of inaccurate marking of the axis when performed by inexperienced surgeons; the patient's head position at the time of slit lamp evaluation also affects the accuracy of axis marking.<sup>4</sup> Another method uses anterior segment photographs to identify iris and/or conjunctival vessel patterns that provide objective marking methods through digital overlay imaging during surgery to evaluate the alignment of the toric IOL, such as with Verion Digital Marker System (Alcon Laboratories, Ft. Worth, Texas, USA).

- **88.46% of eyes treated with Refractive Capsulorhexis were  $\leq 0.5$  D vs. 38.7% of manually marked eyes**
- UCDVA was statistically better post-op in the patients treated with Refractive Capsulorhexis vs. manually marked eyes

# What were my concerns with FLACS?

- ~~• Solving a “problem” that I do not have~~
- **Inefficient time use**
- Cost and ROI

# Time efficiency study

2:15 average time spent for treatment. (Range 1:52 to 3:10)



# What were my concerns with FLACS?

- ~~• Solving a “problem” that I do not have~~
- ~~• Inefficient time use~~
- **Cost and ROI**

# FLACS cost and ROI

- Average retail price for new glasses \$500-700
- Patients are accepting of the cost of 2-3 pair of glasses to not need distance glasses
- 34% of patients choose FLACS for astigmatic treatment



# FLACS is now a core offering

- Win – Win
  - Improved refractive outcomes
  - Excellent patient acceptance of an “affordable” premium option
  - Time efficient delivery
- Positive impact on practice revenue
  - Net contribution of 12%

# Mahalo

