

ASCRS 2012

Crosslinking and Long-Term Hyperopic LASIK Stability Initial Clinical Findings in Contralateral Eye Study

Jonathan B. Kahn, M.D.¹ and A. John Kanellopoulos, M.D.^{1,2}

¹New York University School of Medicine, New York, NY, USA

²Laservision.gr Institute, Athens, Greece

AJK is a consultant for Alcon, Wavelight and Avedro.

Introduction

- CXL is an established treatment for ectasia internationally, although not yet FDA approved, there are several US studies in progress.
- We introduced prophylactic higher fluence CXL in routine LASIK cases 5 years ago, as a means to stabilize the higher myopic corrections and reduce the risk of ectasia.
- Hyperopic LASIK is often thought to regress following the first year.
 - Several theories exist:
 - Latent hyperopia masked by accommodative spasm
 - Epithelial hypertrophy
 - an intrinsic biomechanical effect of hyperopic LASIK, that results in mid-peripheral steepening and central flattening
- We employ topography-guided excimer ablation in our hyperopic LASIK treatments to address significant angle kappa in hyperopia.

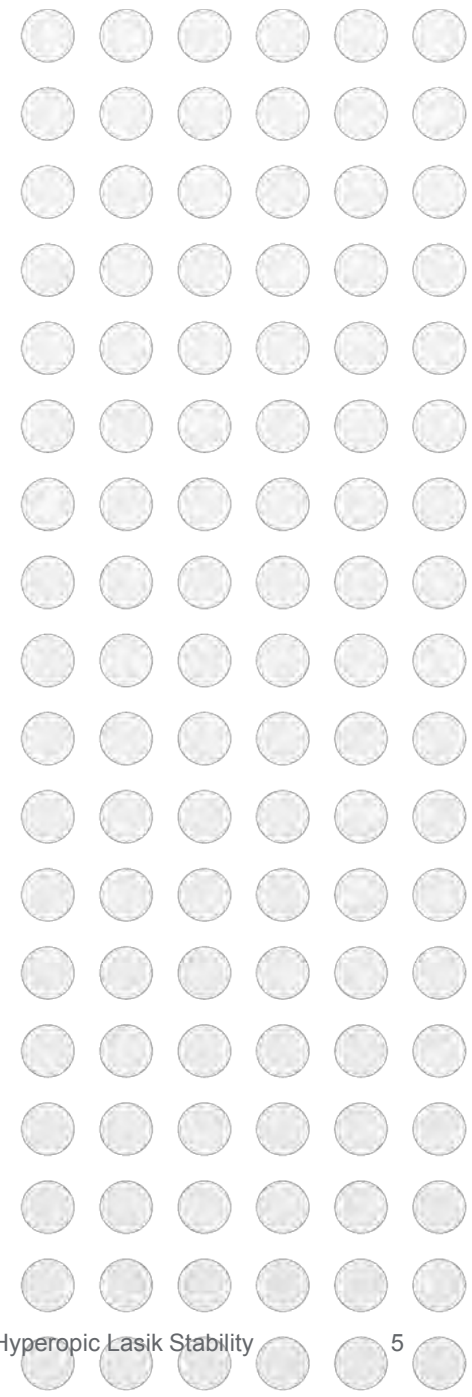
Purpose

- 1) Evaluation of safety and efficacy of intrastromal cross-linking in a contralateral eye study in routine hyperopic LASIK.
- 2) Establish whether CXL would help stabilize corneal steepening resulting from hyperopic LASIK.

Methods


- 27 consecutive patients
 - Mean sphere +3.25 (+1.25 to +6.5)
 - Mean cyl -1.75 (Plano to – 3.25)
- Consecutive hyperopic and hyperopic astigmatic bilateral topography-guided LASIK utilizing the Wavelight (Erlagen, Germany) platform
- Allegretto 400Hz Eye-Q excimer laser and FS200 femtosecond laser flap creation (Alcon, Ft. Worth, TX)
- Randomized
 - Control group: One eye randomised to no adjunct CXL.
 - Treatment group: the contralateral eye was treated with CXL: 1 minute of 30mW/cm² CXL (KXL device, Avedro, waltham, MA, USA) after in-the-flap administration of 1 drop of 0.1% sodium phosphate riboflavin
- Mean follow up of 23 months (22-35)

Video



LASIK flap creation using FS200 femtosecond laser (Alcon, Ft. Worth, TX)

9.5mm LASIK flap nasally decentered, adjusted for angle kappa

| Treatment Parameters (Standard) | | | | | Treatment Screenshot (Standard) |
|--------------------------------------|-------------------------|-------------------------|-------------------------|----------------------------|--|
| Ablation | | | | |  |
| Abl. Zone | Max. Depth | Min. Pachy | Res. Stroma | | |
| 9.0 mm | 104 μm | 597 μm | 363 μm | | |
| Flap | | | | | |
| Diameter | Thickness | Side Cut Angle | Canal Width | Canal Length Offset | |
| 9.5 mm | 130 μm | 70° | 1.3 mm | 1 mm | |
| Hinge | | | | | |
| Position | Length | Angle | Width | | |
| 90° | 3.6 mm | 45° | 0.4 mm | | |
| Laser pulse energy (measured) | | | | | |
| Bed Cut | | Side Cut | | | |
| 0.8 μJ | | 0.9 μJ | | | |
| Laser separations | | | | | |
| Bed Cut | | Side Cut | | | |
| Spot Separations | Line Separations | Spot Separations | Line Separations | | |
| 8.0 μm | 8.0 μm | 5.0 μm | 3.0 μm | | |
| Comments | | | | | |

Topo-guided LASIK excimer treatment plan centered on visual axis

Treatments WaveLight

OD 

01:00

Patient (F5)

Diagnostic (F6)

Treatment Planning (F7)

Treatment (F8)

Documentation (F9)

Setup (F10)

Laser (F11)

Diagnosis Details

Refraction: +6.00 D +0.25 D @ 35° / 12 mm

Pupillometry: 6.50 mm

Pachymetry: 675 μm 651 μm 597 μm 660 μm 682 μm

K1-Readings: 41.16 D @ 175° / —

K2-Readings: 41.72 D @ 86° / —

Treatment Details

Measured: +0.27 D -0.72 D @ 174°

Modified: +6.00 D +0.25 D @ 35°

Q-Value: 0.00

Optical Zone: 6.50 mm Flap: 150 μm

Ablation Zone: 9.00 mm Cornea: 597 μm

Max. Ablation: 105 μm Res. Stroma: 416 μm

Central Ablation: 1 μm

Ablation Profile:



Max: 104.49 μm min: 0.04 μm

Information

OD was centered on visual axis

Shots done: 17606/17606 (100%)

Treatments

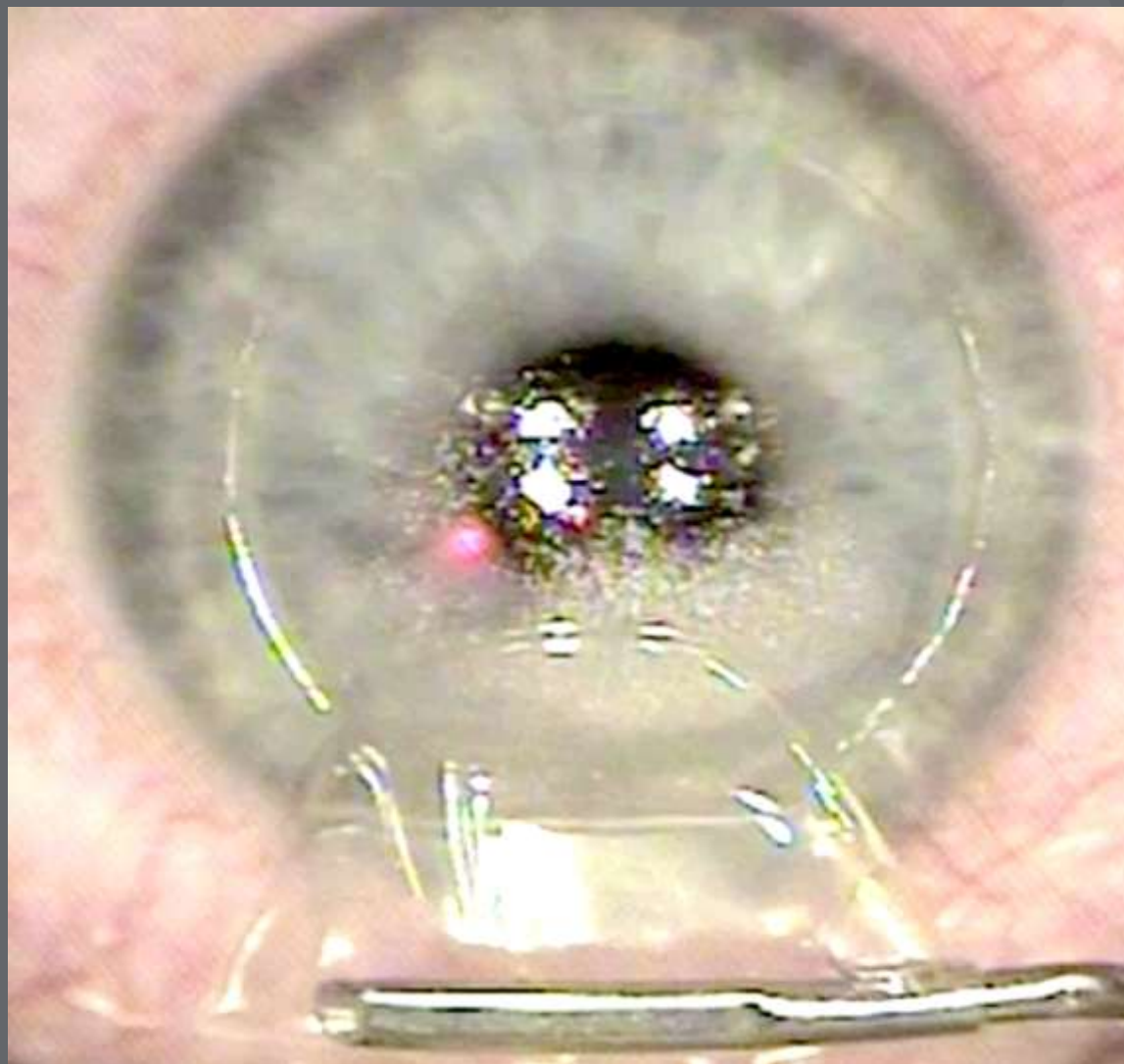
| Patient | Eye | Method | Date | Planned by | Confirmed by |
|---------|-----|--------------|---------------------|------------|--------------|
| | OD | Topoguide... | 16-11-2011 10:43:04 | Leak, Leak | Leak, Leak |
| | OS | Topoguide... | 16-11-2011 10:37:52 | Leak, Leak | Leak, Leak |

Info & Warnings

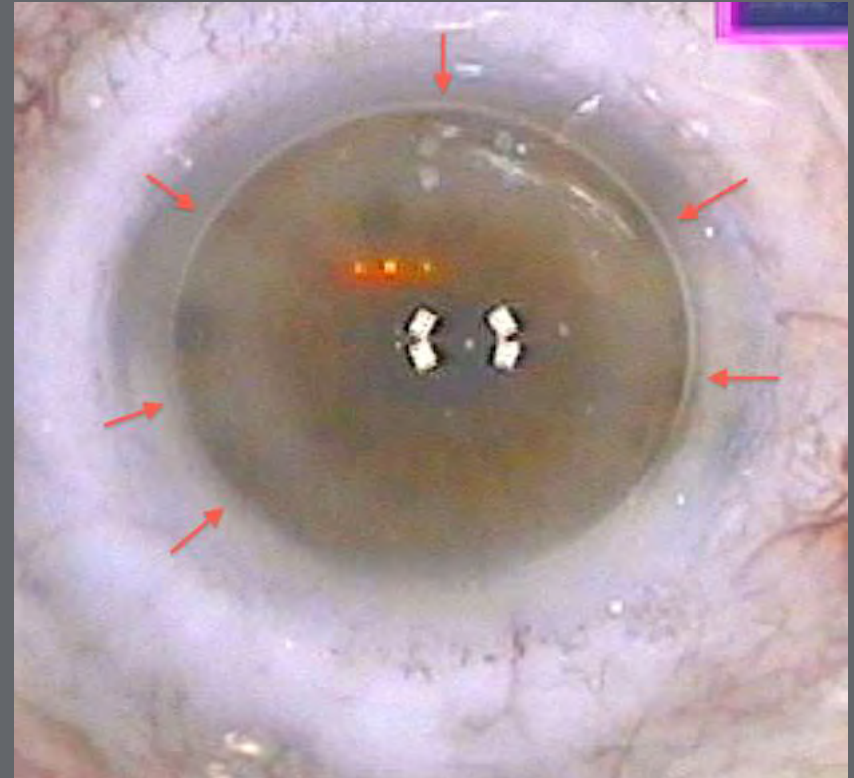
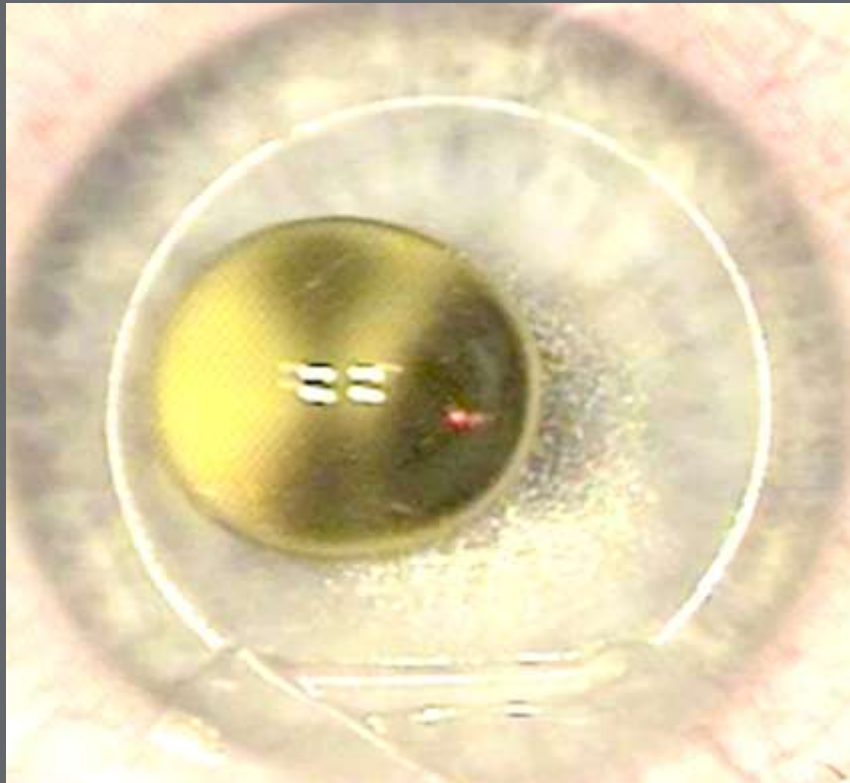
 Patient filter active

⊞ Laser is in system test mode
⊞ Lask
⊞ 50%
10.01.2012 14:37:09

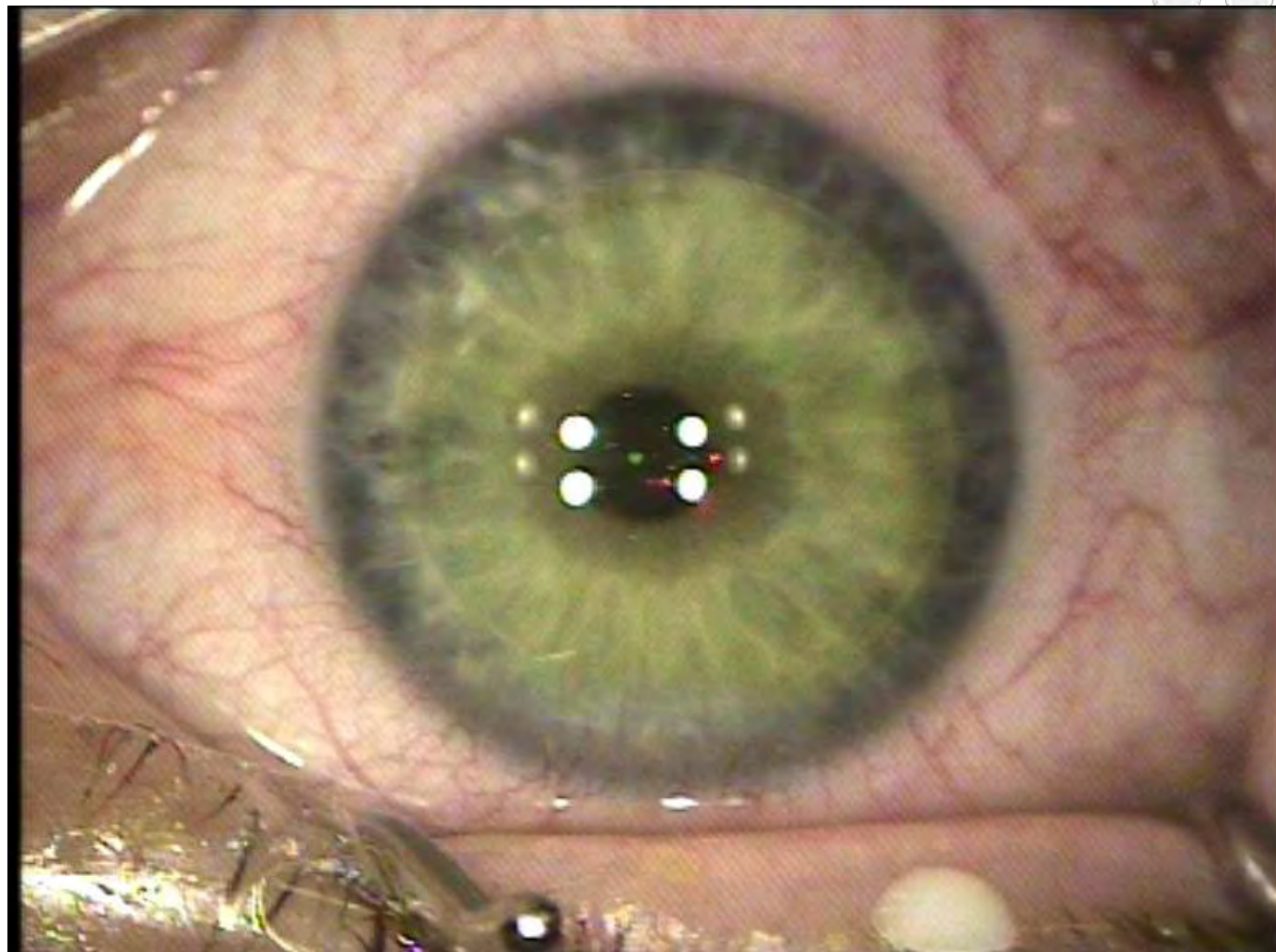
Lifting the femto-created flap



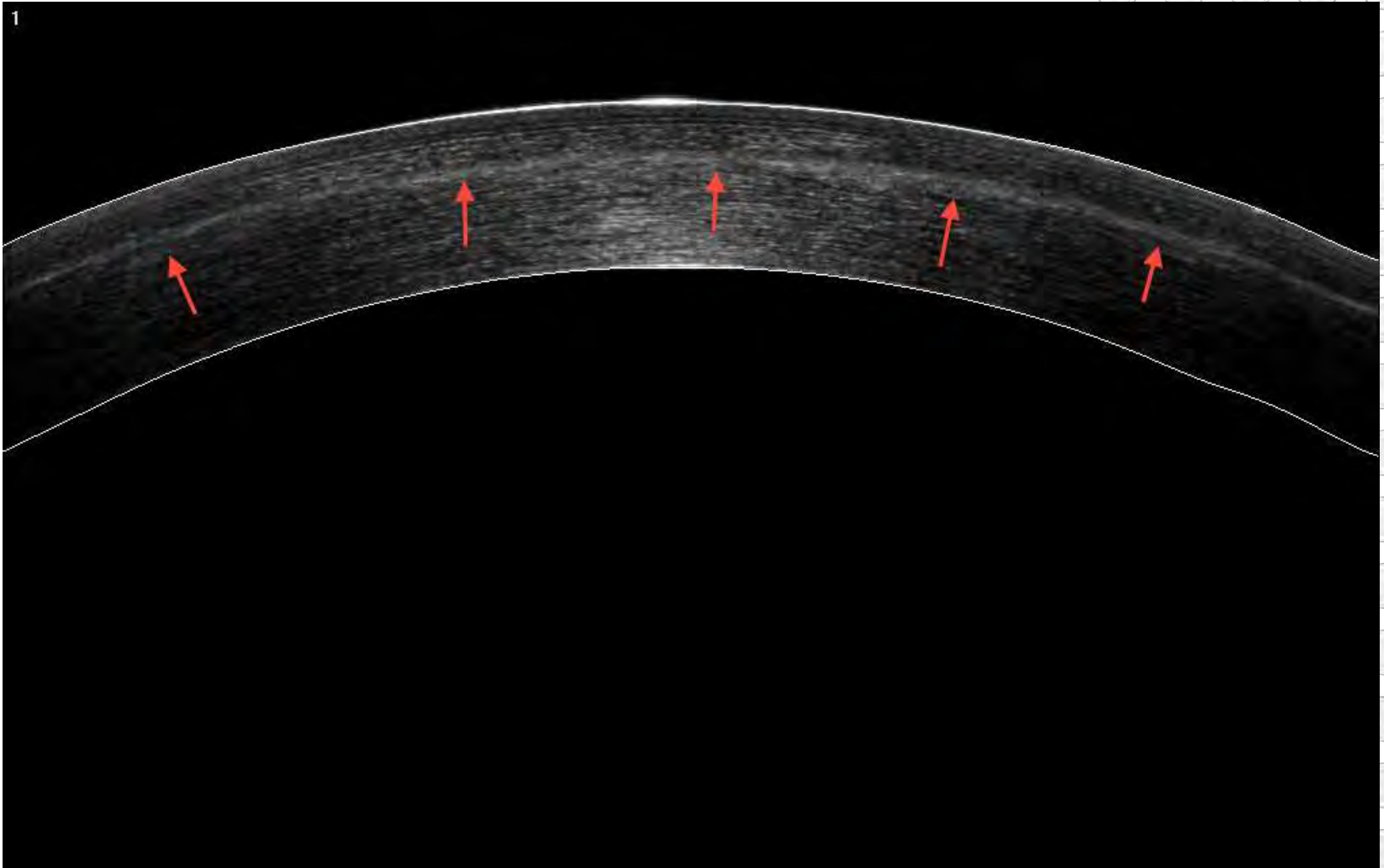
A drop of 0.1% riboflavin sodium phosphate solution (Leiter's pharmacy, San Jose, CA)



Flap repositioned following stromal soak with riboflavin



Corneal OCT (Optovue, CA, USA) in LASIK Xtra group



Results

- Outcome measures:
 - Peri-operative refractive error
 - Keratometric, topographic and topometric measurements
- Mean regression from treatment:
 - Control cases: +0.72 D
 - CXL cases: +0.22 D

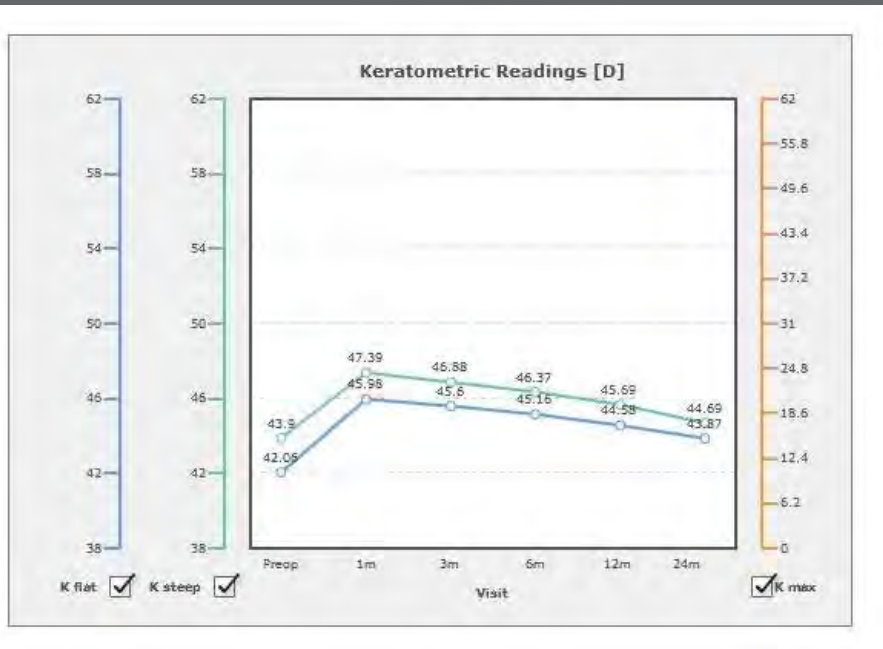
LASIK Control Group



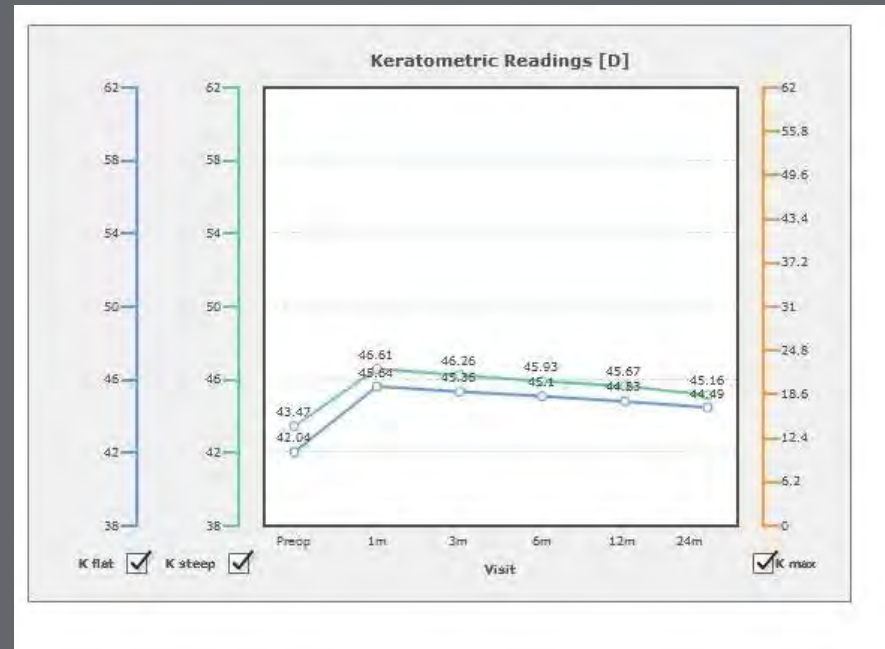
LASIK CXL Group



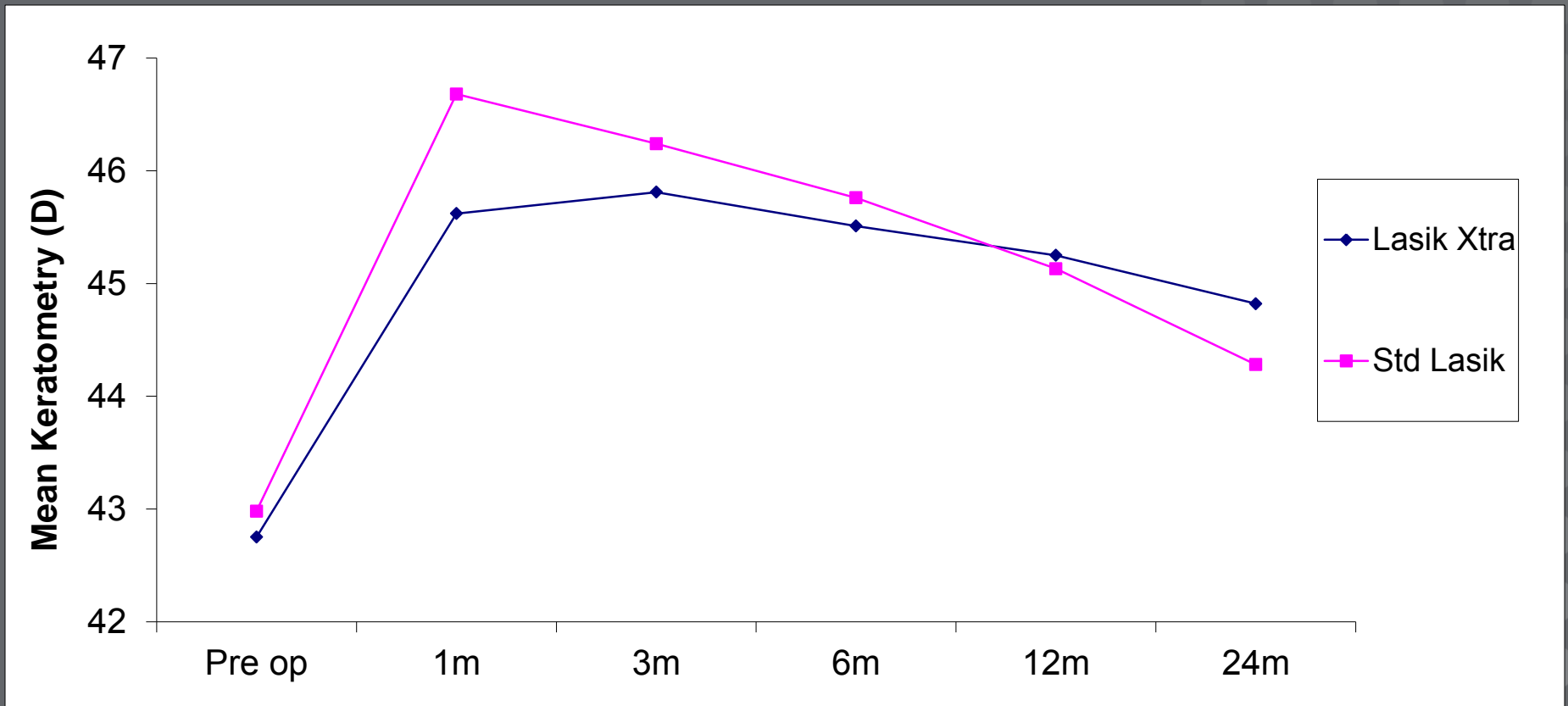
LASIK Control Group



LASIK CXL Group

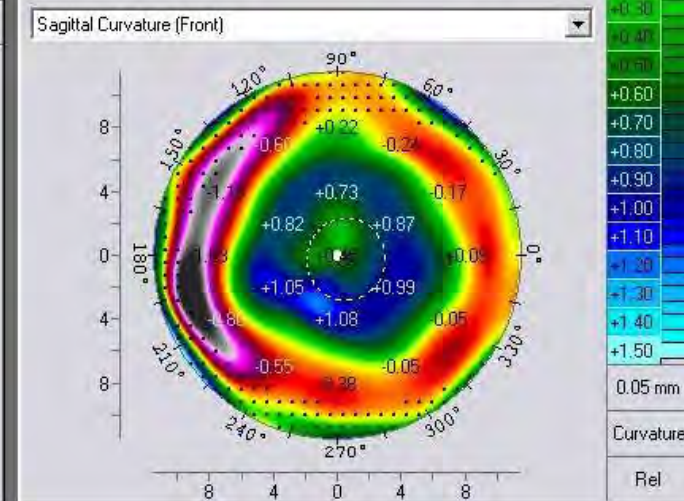
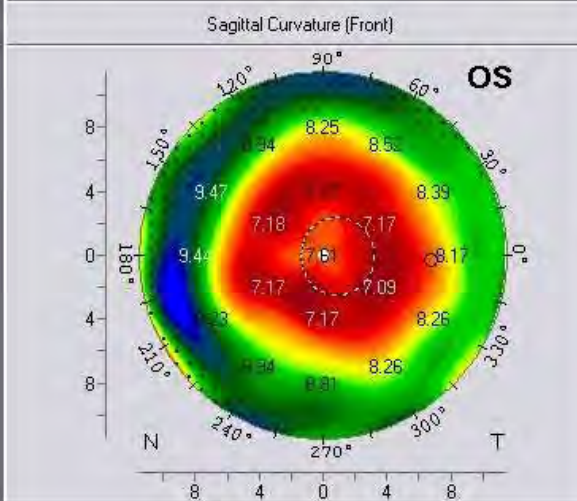
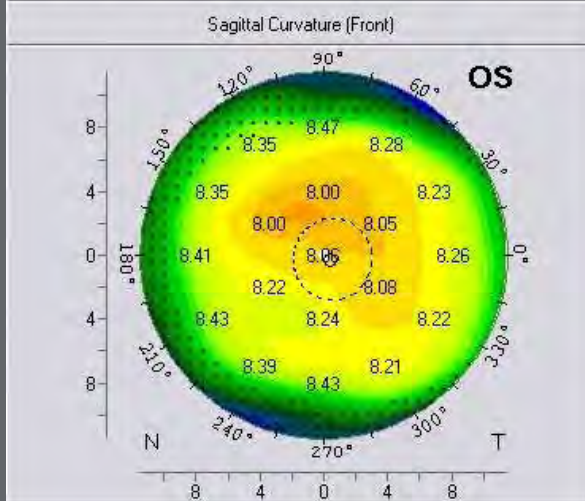
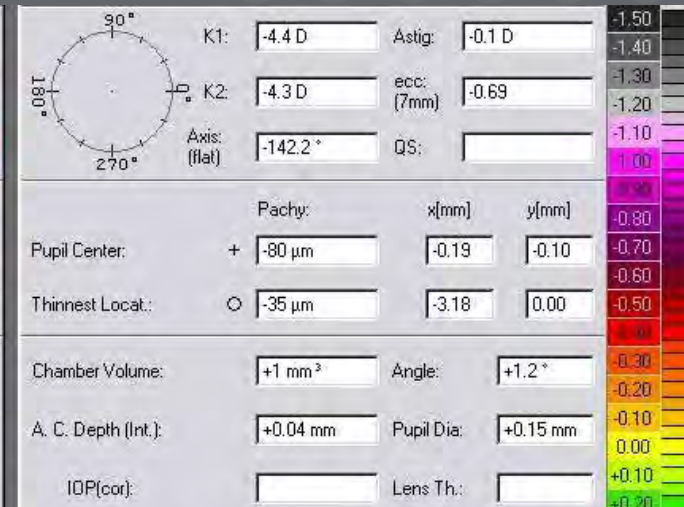
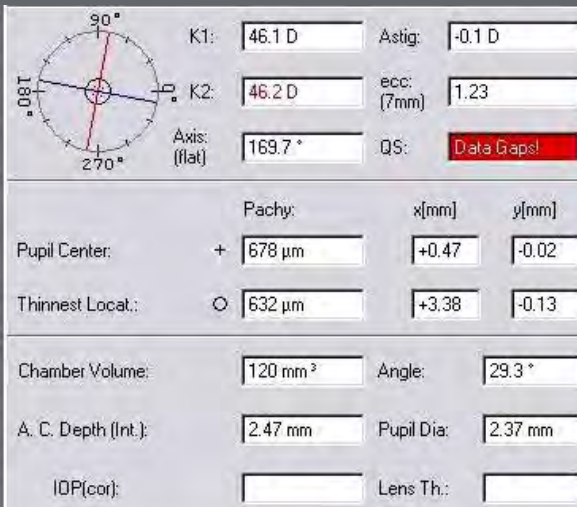
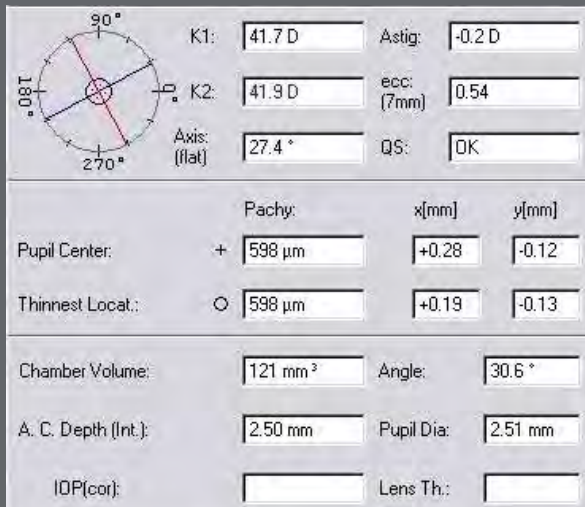


Comparison of Keratometric Stability

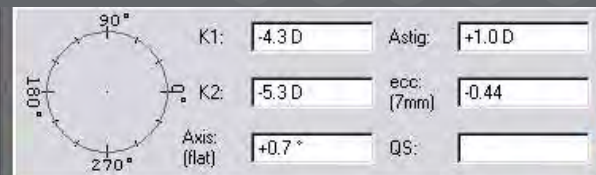


LASIK Control Group

1 year



LASIK CXL Group 1 year



| | | |
|---------------------------|-------|-------|
| Pachy: | x(mm) | y(mm) |
| Pupil Center: + 595 μm | -0.20 | -0.21 |
| Thinnest Locat.: O 595 μm | -0.36 | -0.12 |

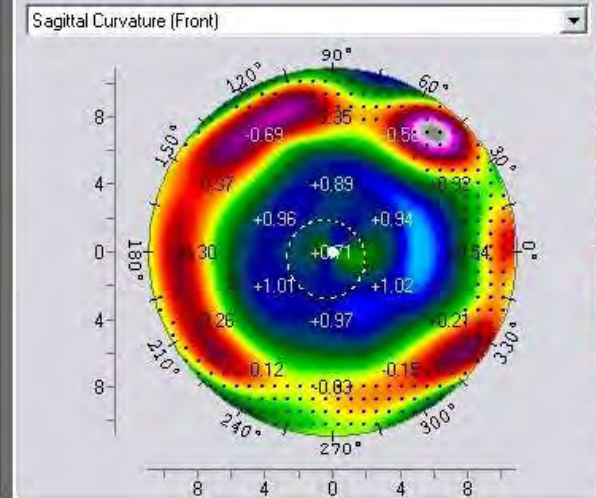
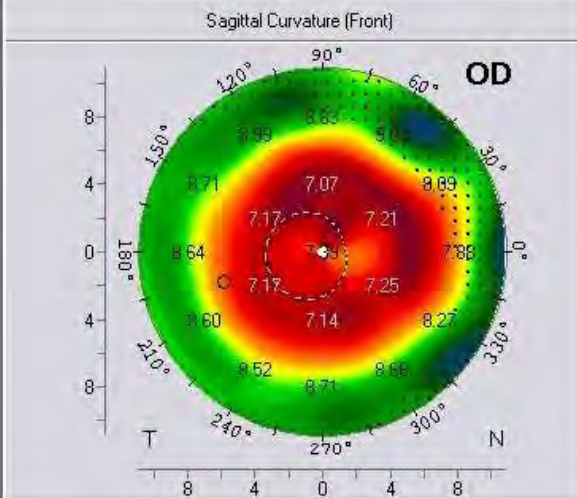
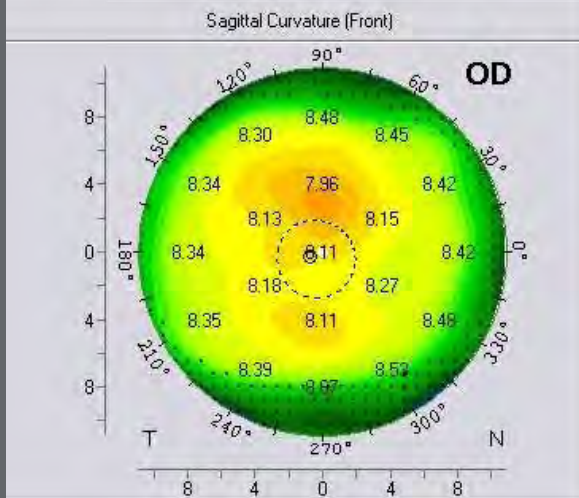
| | | |
|---------------------------|-------|-------|
| Pachy: | x(mm) | y(mm) |
| Pupil Center: + 722 μm | -0.51 | -0.12 |
| Thinnest Locat.: O 663 μm | -2.93 | -0.91 |

| | | |
|--------------------------|-------|-------|
| Pachy: | x(mm) | y(mm) |
| Pupil Center: + 127 μm | +0.31 | -0.09 |
| Thinnest Locat.: O 68 μm | +2.57 | +0.79 |

| | |
|---------------------|------------|
| Chamber Volume: | Angle: |
| 119 mm ³ | 30.6° |
| A. C. Depth (Int.): | Pupil Dia: |
| 2.50 mm | 2.31 mm |
| IOP(cor): | Lens Th.: |

| | |
|---------------------|------------|
| Chamber Volume: | Angle: |
| 118 mm ³ | 33.4° |
| A. C. Depth (Int.): | Pupil Dia: |
| 2.45 mm | 2.49 mm |
| IOP(cor): | Lens Th.: |

| | |
|---------------------|------------|
| Chamber Volume: | Angle: |
| +1 mm ³ | -2.8° |
| A. C. Depth (Int.): | Pupil Dia: |
| +0.05 mm | -0.17 mm |
| IOP(cor): | Lens Th.: |



Conclusions

- Combination of CXL in routine hyperopic / hyperopic-astigmatic LASIK is safe and appears to significantly stabilize its long term effects, possibly by modulating a hyperopic LASIK biomechanical response.
- These data support our theory that long term regression in hyperopic / hyperopic-astigmatic LASIK may involve corneal biomechanical changes.