Lasik Xtra in:
Hyperopia
AK Xtra
Clear cornea cataract surgery

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

Kanellopoulos, MD
CXL has been 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 chance for ectasia.

Hyperopic LASIK is often thought to regress following the first year. The etiology for this has been elusive, several theories exist:

A- latent hyperopia masked by accommodative spasm,
B- epithelial hypertrophy, and
C- an intrinsic biomechanical effect of hyperopic LASIK, that results in mid-peripheral steepening and central flattening.

We have employed topography-guided excimer ablation in our hyperopic LASIK treatments for almost a decade in order 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-We speculated that the CXL would help stabilize the cornea steepening result of hyperopic LASIK, that may regress within the first 2 years.

Crosslinking and Long-Term Hyperopic Lasik Stability
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 400Hxz Eye-Q excimer laser and femtosecond laser flap creation

• 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)
A FS200 femto (Alcon, Ft Worth, USA) 9.5mm hyperopic LASIK flap. It’s nasal decentration is evident in reference to the red circle that represents the pupil-this is done in order to accommodate the topography-guided ablation that will be also nasally decentered to accommodate angle kapa.
A drop of 0.1% riboflavin sodium phosphate solution, just prior to its spread over the exposed stromal bed
Flap repositioned following stromal soak with riboflavin, that is now visible as yellow tinge in the stroma
CXL evidence viewed in 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
Xtra Group

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Comparison of Keratometric Stability

![Graph showing comparison of Mean Keratometry (D) between Lasik Xtra and Std Lasik over time (Pre op, 1m, 3m, 6m, 12m, 24m).]
LASIK Control Group
1 year

<table>
<thead>
<tr>
<th>K1</th>
<th>K2</th>
<th>K3</th>
</tr>
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<tbody>
<tr>
<td>41.7°</td>
<td>41.8°</td>
<td>41.0°</td>
</tr>
<tr>
<td>Axial: 0.2 D</td>
<td>0.54 D</td>
<td>0.1 D</td>
</tr>
<tr>
<td>Ecc: 27.4°</td>
<td>169.7°</td>
<td>142.2°</td>
</tr>
<tr>
<td>GS: OK</td>
<td>GS: Data Gap!</td>
<td>GS:</td>
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<table>
<thead>
<tr>
<th>Pupil Center:</th>
<th>±590 μm</th>
<th>±679 μm</th>
<th>±40 μm</th>
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<tbody>
<tr>
<td>x(mm): 0.26</td>
<td>±0.27</td>
<td>±0.47</td>
<td>±0.19</td>
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<tr>
<td>y(mm): 0.12</td>
<td>±0.13</td>
<td>±0.02</td>
<td>±0.10</td>
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<table>
<thead>
<tr>
<th>Chamber Volume:</th>
<th>121 mm³</th>
<th>120 mm³</th>
<th>110 mm³</th>
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</thead>
<tbody>
<tr>
<td>A. C. Depth (Inc.):</td>
<td>2.50 mm</td>
<td>2.47 mm</td>
<td>2.15 mm</td>
</tr>
<tr>
<td>IDP (cor):</td>
<td>Lira Tisi</td>
<td>Lira Tisi</td>
<td>Lira Tisi</td>
</tr>
</tbody>
</table>

Sagittal Curvature (Front)

New York University School of Medicine
Kanellopoulos, MD
LaserVision.gr
LASIK CXL Group
1 year

New York University School of Medicine
Kanellopoulos, MD

Crosslinking and Long-term Hyperopic Lasik Stability
Conclusions

• Combination of CXL in routine hyperopic and hyperopic-astigmatic LASIK appears to significantly stabilize its long term effect, possibly by modulating a hyperopic LASIK biomechanical response.

• These data support our theory that long term regression in hyperopic and hyperopic-astigmatic LASIK may involve corneal biomechanical changes.
Enhancement of femtosecond astigmatic keratotomy (fsAK) with combined simultaneous high fluence CXL (hfCXL)

Kanellopoulos: Presented at AAO 2012
Methods

15 eyes of 13 consecutive patients
Standard follow-up up to 6 months
Protocol:
- Two 30° arcuate OCT guided fsAK incisions were performed with the LenSx laser at the 7mm OZ, 85% depth
- Manual incision separation with a Sinskey hook
- 1 drop of 0.1% riboflavin sodium phosphate was administered in one of the incisions
- 60 seconds soak
Results

The CXL incisions showed statistical significance in the meridional astigmatic change to the non-CXL incisions:

• at day 1 (2.75D to 1.75D)
• week 1 (2.50D to 1.65D)
• month 1 (2.25D to 1.45D)
• month 3 (2.25D to 1.25D).
AK Xtra Post Penetrating Keratoplasty
video
Astigmatic change following LenSx-placed AK insiions on the steep axis
Astigmatic change following high-fluence CXL enhancement
Femto AK combined with CXL!
30mW cm² X 3 min
Kanellopoulos 2012

After AK

AK after high fluence CXL
Older AK + LASIK after enhanced with AK Xtra
High fluence CXL AK-enhancement
What happens to the cornea topometric parameters with clear cornea cataract surgery?
Cataract surgery patient: toric IOL or AK or LASIK after?
Cataract surgery patient
one eye randomized to flash CXL:
Guess which eye of this same patient has flash CXL with the clear cornea cataract incision?
flashCXL of clear cornea cataract incisions!

Kanellopoulos 2012

Control

Flash CXL
Our current CXL protocols

• 1- Athens Protocol: topoPRK +10 ㎡ 10mw/cm²
• 2-LASIK Xtra: 1 ㎡ 90 ㎡ 30mW/cm² all HYPERO
• 2-PRK Xtra: 1 ㎡ 90 ㎡ 30mW/cm²
• 3- femtoAK Xtra: 3’ 30mw/cm²-no soaking!
• 4-Cataract incision Xtra: 45mW/cm² for 2.5 min
• 5-TransepiCXL: 0.25% ribo + 30mW X 3 ㎡
• 6-Infection: 0.25% riboflavin + 45mW/cm² x 5 ㎡
Conclusions: very high fluence CXL

LASIK Xtra may be the preferred way to perform LASIK in myopes, we have proven that it maybe necessary for long term stability of hyperopic LASIK.

This novel combination of hfCXL may significantly enhance fsAK efficacy allowing for a smaller arc treatment, potentially higher stability and lesser ocular surface symptoms.

This novel combination of hfCXL may significantly enhance steep axis flattening in clear cornea cataract surgery.