

“Crosslinking...or not”

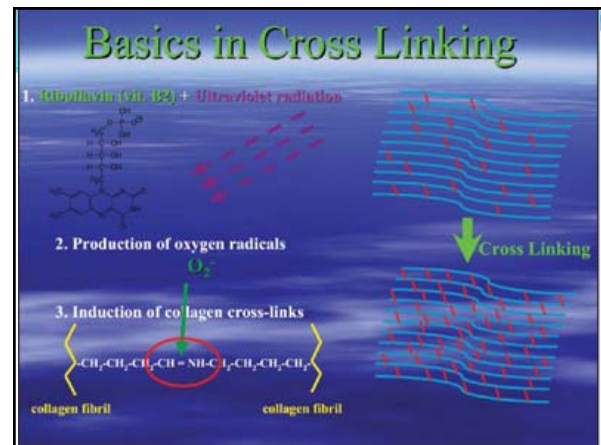
Richard A. Erdey, MD
Erdey Searcy Eye Group
Sun March 6, 2016

Irregular Astigmatism

- Soft Toric CL
- GPHCL
- Scleral lenses
- Corneal Cross linking
- Intacs
- Corneal Transplantation (DALK/PKP)

Corneal cross linking with UV-light and Riboflavin

- US FDA studies began early 2008
- European prospective studies began 2003
- Goal: stop progression of keratoconus



Goal: Cross-linking

- Increase compaction of cornea lamellae
- Increase rigidity, resistance
- Refractive and aberration changes are side effects of tissue changes
- cytotoxic reaction of singlet oxygen: treatment of bacterial, fungal and protozoal infections of the cornea.

CXL: parameters to judge response

- OCT: Depth of demarcation line
- Biomechanical improvement
- Scheimpflug or OCT elevation changes in shape
- Pachymetry changes – thinning to thickening
- Epithelial changes - OCT

CXL: Epi Off Protocols
deeper demarcation line:

- more tissue CXL
- stronger
- Longer term stability
- More refractive changes
- Avoid exposure to endothelium!

Cross Linking: Epi on protocols

- More comfortable
- Less effect?
- Repeat procedure?

Standard CXL:
European long term follow up 2000 cases

Intraoperative measurements

Up to 9 yrs follow up:

- Age
- Curvature
- Pachmetry

The image displays four abstracts from scientific journals:

- Corneal Cross-Linking as a Treatment for Keratoconus: Five-Year Morphologic and Clinical Outcomes with Respect to Patient Age** by Scott J. Higgins, MD, PhD, et al.
- Refractive, Topographic, Tomographic, and Aberrometric Analysis of Keratoconic Eyes Undergoing Corneal Cross-Linking** by Paul Vinciguerra, MD, et al.
- Intraoperative and Postoperative Effects of General Collagen Cross-linking on Progressive Keratoconus** by Scott J. Higgins, MD, et al.
- Two-Year Corneal Cross-Linking Results in Patients Younger Than 18 Years With Documented Progressive Keratoconus** by Paul Vinciguerra, MD, et al.

CXL: Mild keratoconus:
Reduction of posterior elevation over time

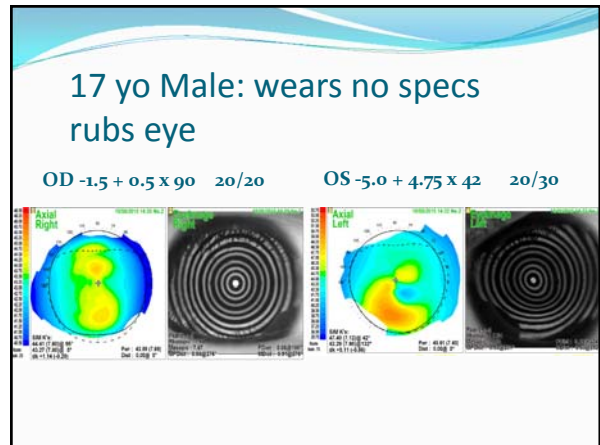
CXL: Mild keratoconus:
Pachy over time increases pre-op, 1mos, 4 mos

CXL: SECONDARY changes

- Visual Acuity BSCVA over time improves
- Refractive Changes: Curvature flattens
- Aberrometry Changes: improves, less Coma

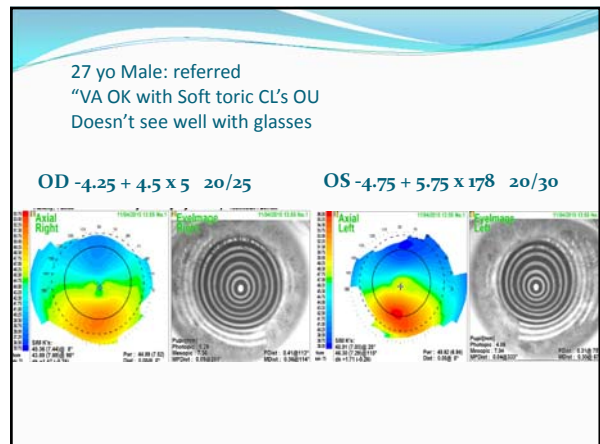
CXL
Astigmatism: NO Change Over Time

CXL:
Irregular to Regular astigmatism



17 yo male:Keratoconus OS
Treatment? Optical vs Surgical

- Contact Lens fit OS: Soft toric or GPHCL
- Quit rubbing eye
- Repeat Topography 4 mos.
- Stable? Toric ICL
- Progression? Crosslink with/without Topoguided PRK



27 yo: Keratoconus: Options

- Stay in SCL's, or consider GPHL, Scleral CL
- Intacs OU
- Staar Surgical toric ICL (EU)
- Collagen Cross Link if progression

15 yo Male: 2009

OD -2.75 + 2.5 x 140 20/150 OS -2.75 + 2.25 x 010 20/25

17 yo Male: 1 yr CXL OS 2010

OS -2.0 + 3.0 x 178 20/30

CXL – RK/LASIK/PRK induced Ectasia

Corneal Collagen Cross-linking for Ectasia After Excimer Laser Refractive Surgery: 1-year Results

Paolo Vinciguerra, MD; Fabrizio I. Camesasca, MD; Elena Albè, MD; Silvia Trazza, BS

CXL –LASIK/PRK induced Ectasia

- Reduction curvature over time

CXL – RK induced Ectasia

- Reduction area/power of ectasia over time

CXL - RK Ectasia progressive hyperopia with diurnal fluctuation - then PRK??

- Staged hyperopic PRK six mos later?
- Markedly delayed optical rehabilitation
- Diurnal fluctuation only improved 50%
- Long term stability?

Mild Keratoconus

CXL – then same day topoguided PRK??

- Studies continue
- Long term stability?

Collagen cross-linking complications - epi off tech

- Immediate post-op experience miserable
- Remove epith 10-11 mm, then irradiate with UV – pain prolonged re-epithelialization
- Cornea infection – infiltrate/ulcer
- Death nearly all keratocytes in RX area
- Repopulation occurs over time
- Transient haze can be significant – 1 year
- vision worse several months
- Regenerating subbasal nerves remained disoriented at 5 years
- Long term effects/stability unknown

Summary

Cross Linking – Indications:

- Consider with mild – moderate keratoconus with documented progression

Summary

Crosslinking: Pediatric Procedure

- Safe technique
- Low rate complications IF CORRECTLY DONE
- Treat Pediatric Keratoconus 9-12 yo early EPI-OFF
- Save 6,000 grafts/yr in USA (keratoconus)

Potential contraindications


- thin corneas <400u where cytotoxicity could damage the endothelium
- keratoconus with unreasonable pt expectations
- Advanced keratoconus
- Advanced ectasia - Lasik/RK induced
- severe ocular surface disease where treatment could lead to the instability of the ocular surface.

Corneal Cross Linking - 2016 NOT - US FDA approved!

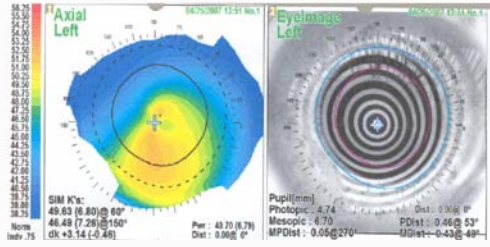
- Feb 2015 FDA advisory panel “cautious nod”
- Narrowly voted to approve riboflavin (Photrex – Avedro) and Photrex Viscous (with dextran) based on 12 mo data
- Indications: progressive keratoconus and lasik induced ectasia?
- Long term efficacy data >12mos required.

INTACS

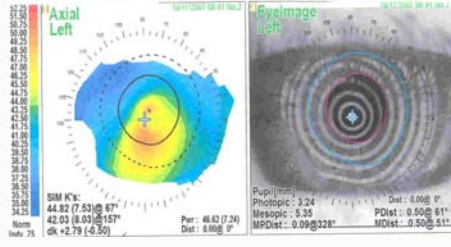
- 150° arcs PMMA
- Additive technique
- Reshape cornea
- More GPHCL tolerant
- More refractable
- Avoid corneal transplant
- removable



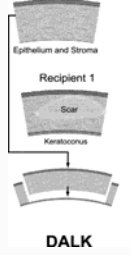
Keratoconus, Pre-op Intacs: OS -10.5 + 2.5 x 80 20/30-



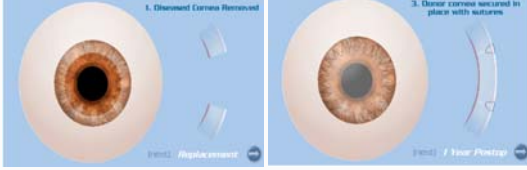
Keratoconus, 6 mos s/p Intacs: OS Plano 20/40+



Deep Anterior Lamellar Keratoplasty (DALK) :



100 yrs : So what's wrong with Penetrating Keratoplasty (PK)?

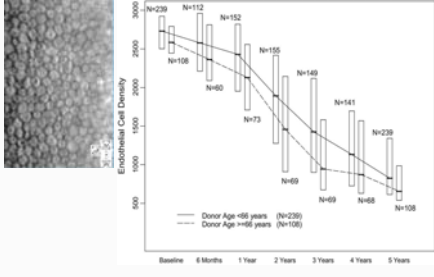


PK's – Scourges Cornea Graft Rejection



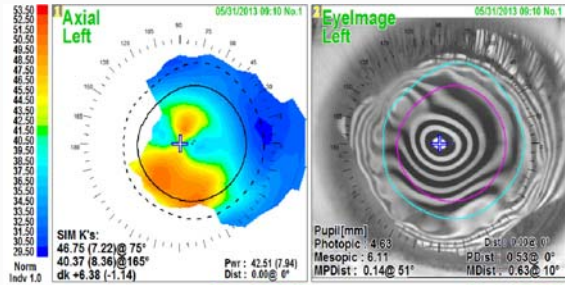
Cornea Donor Study

Ophthalmology 2008 - Cornea Donor Study Investigator Group



Time Point	Donor Age ≤ 65 years (N=239)	Donor Age ≥ 66 years (N=108)
Baseline	~2800	~2800
6 Months	~2600	~2600
1 Year	~2400	~2400
2 Years	~2200	~2200
3 Years	~2000	~2000
4 Years	~1800	~1800
5 Years	~1600	~1600

20 y/o PK 7.5mm – keratoconus suture in 1 yr after surgery



SHM K's:
46.75 (7.22) @ 75°
40.37 (8.36) @ 165°
dk +6.38 (-1.14)

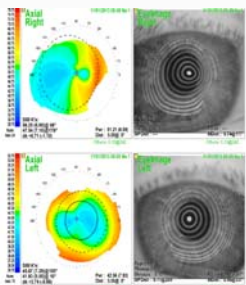
PWR: 42.51 (7.94)
Dist: 6.00 @ 0°

Pupil [mm]
Photopic: 4.63
Mesopic: 6.11
MPDist: 0.14 @ 51°

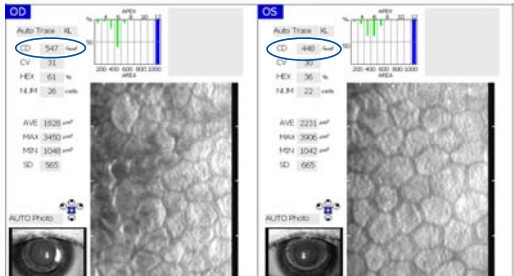
Dist: 0.09 @ 0°
PDist: 0.53 @ 0°
NDist: 0.63 @ 10°

Keratoconus: Late Ectasia

59 yo PK OU 1984, 85 @ OSU
CCT: 650 OU



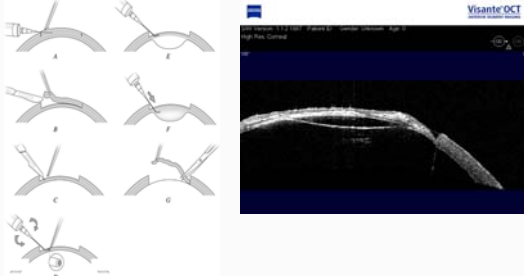
Keratoconus PK OU 1984, 85 @ OSU



OD: CV 31, HD 761, 14.84 26, AVE 1828, MAX 3420, MD 13042, SD 1565

OS: CV 30, HD 761, 14.84 22, AVE 1229, MAX 3906, MD 13042, SD 1665

Deep Anterior Lamellar Keratoplasty (DALK) Big Bubble



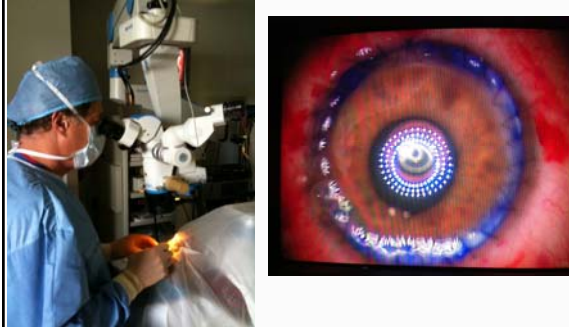
Intraoperative Keratometer

DALK/PK – before suture adjustment



This image shows a surgeon in blue scrubs and a cap, positioned at an intraoperative keratometer. The device's camera captures the cornea, displaying a circular topographic map with concentric rings and a central blue spot. The map indicates the curvature of the cornea before any sutures are adjusted.

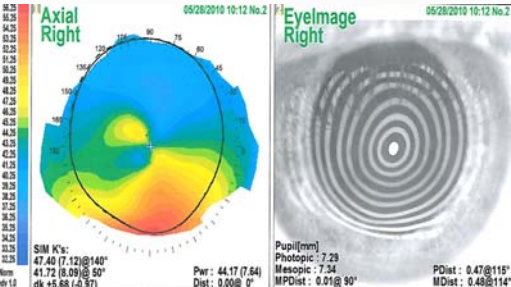
DALK – after suture adjustment:
improves early optical rehabilitation



This image shows the same surgeon at the keratometer after adjusting the sutures. The topographic map now shows a more regular, circular pattern with concentric rings, indicating a more spherical corneal shape compared to the previous image.

LASIK Ectasia: 48yo male, CL intol

-7.0 + 7.0 x 20/50




This slide displays two diagnostic images for a 48-year-old male with LASIK ectasia. On the left is an 'Axial Right' topographic map showing a highly irregular, elongated shape with a color scale from blue (steeper) to red (flatter). On the right is an 'EyeImage Right' showing concentric rings. Below the maps are the following parameters:

SIM K's:	Pupil(mm)	Photopic: 7.23	PDlat: 0.47@115°
47.40 (7.12)@140°			
41.72 (8.09)@50°		Mesopic: 7.34	
dk +5.69 (-0.97)		MFDist: 0.01@90°	MDist: 0.48@114°
		Pwr: 44.17 (7.64)	
		Dist: 0.00@0°	

DALK: 8 mos post-op (2 mos after suture removed)

+1.25 + 1.5 x 175 x 20/20-



This slide shows the results 8 months post-DALK surgery. It includes an 'Axial Right' topographic map showing a regular, circular shape, an 'EyeImage Right' with concentric rings, and a clinical photograph of the eye. The parameters below are:

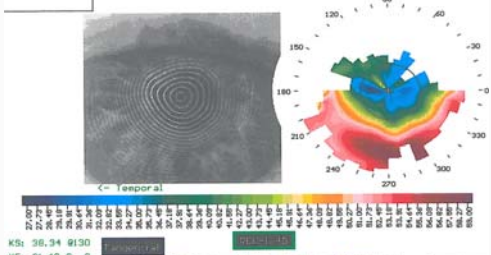
SIM K's:	Pupil(mm)	Photopic: 7.23	PDlat: 0.47@115°
44.37 (0.36)@120°			
43.16 (0.41)@120°		Mesopic: 7.34	
dk +4.87 (-4.12)		MFDist: 0.01@90°	MDist: 0.48@114°
		Pwr: 48.38 (8.28)	
		Dist: 0.00@0°	

64 yo male with cataract & RK OU

- 1995 RK OU elsewhere
- Progressive hyperopia OU
OD +7.25 + 2.25 x 137 20/70
OS +4.50 + 2.25 x 025 20/30
- Rx: Scleral contacts OU increasing intolerance / cataracts

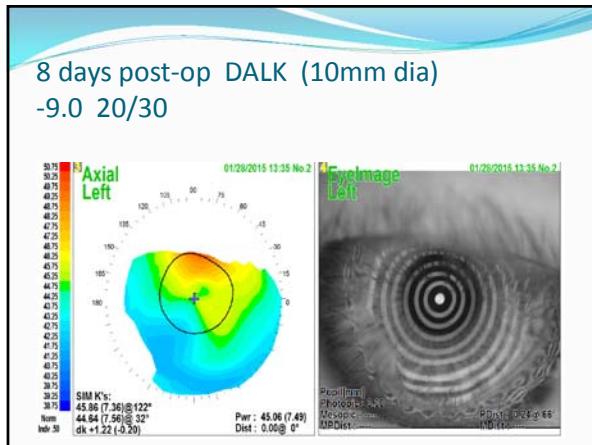
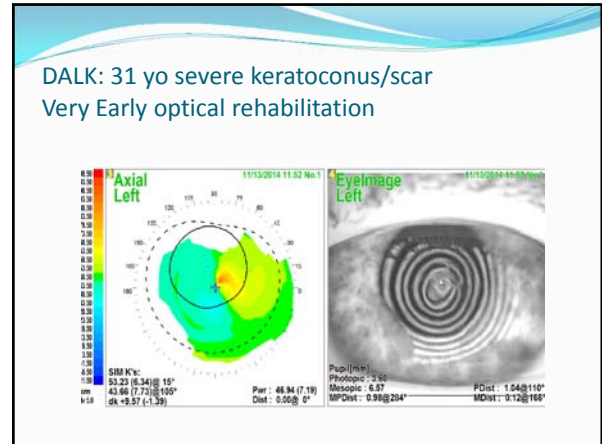
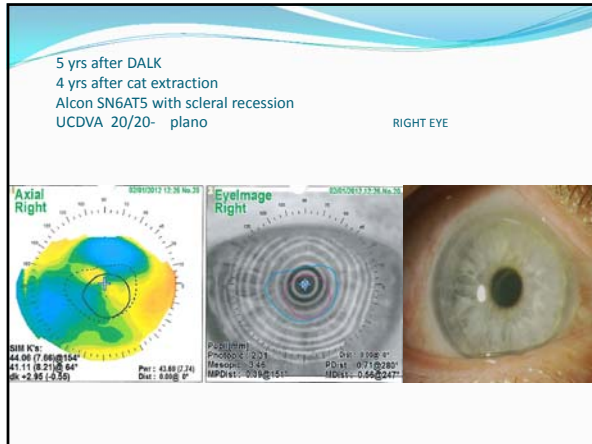
64 year old with cataract and RK Right Eye

Progressive hyperopia, irregular astigmatism
OD: +7.25 + 2.25 x 137 20/70



This slide shows the topographic and EyeImage Right for the 64-year-old male. The 'Axial Right' topographic map shows an irregular shape with a color scale from blue to red. The 'EyeImage Right' shows concentric rings. Below the maps are the following parameters:

Ks: 36.34 @130	Axis: 0	Distance: 0.00	Radius: 9.42	Power: 39.84	Z_Dornea: 0.00
Kf: 31.49 @ 0					
KD: 6.85					



- DALK vs PK - 2014
Are we conserving recipient endothelial cells during surgery and what is long term graft survival?
- DALK = 832 (5.5%)
 - PK = 20,282
primary = 14,285 (6,224 keratoconus)
regrafts = 5,997

Thank You!