New and Improved Femtosecond Laser Applications

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When birds don’t fly, neither should you.
When cows bunch together in a field, a storm is coming.
When ants begin to pile dirt around the edge of their hole, it’s going to rain.

I am a consultant and receive travel support from AMO/IL and I have borrowed so many slides, videos, and pictures it would take me twelve minutes to thank everyone.
New and Improved Options with the Intralase

- Anterior Lamellar Keratoplasty
- Intracorneal Ring Segments for Keratoconus and Ectasia
- Posterior Lamellar Keratoplasty
- Full Thickness Keratoplasty
- Astigmatic Keratotomy
- Corneal Wedge Resection
- Cataract incision
- Intrastromal Inlays
FDA Cleared Cut Patterns

Patterns may be angled or curved
Anterior Lamellar Keratoplasty

Current recommend depth limit of 250 microns
Reis Bucklers Dystrophy

- 36 Year Old Female
- Family History
  - Mother
  - Aunt
  - Grandmother
  - (All with PKP’s +/- success)
- Previous Surgery
  - Biomask Procedure-Left Eye
Surgery
Postoperative Results

- BCVA-20/32
- -4.50+0.5 x 90
- 6 month postop
- CL-20/32
- 1 year postop
- Lasik-UCVA 20/25
Deep or Posterior Lamellar Keratoplasty
Deep Lamellar Keratoplasty

• How deep can we go, safely?
• How flat can you make a cornea?
• Does it work?
### Equivalent K-Readings (4.5mm Zone)

- **K2:** 31.5 D (40.1°)
- **Astig:** 5.1 D
- **K1:** 26.4 D (130.1°)
- **Q (4.5mm):** 7.62
- **Km:** 29.0 D

**Details**

#### Abnormal Cornea

- Alignment: K1, K2, K3
- Axis: 130°, 40°, 70°
Current Issues

Ridges on deep cuts
Advanced Shaped Penetrating Keratoplasty

- Using mechanical instruments
- In 1964, Jose l. Barraquer described a two-level keratoplasty
  - Characterized by the different size of the graft at the level of the anterior and posterior layers
Time Line For PK With Intralase

• First Cases with Prototype laser-11/05
• First Cases with up graded standard laser used for Lasik surgery-7/06
• There have now been hundreds of cases performed both in the US and internationally
• SightLife (Seattle), Iowa, and TBI Eye Banks now preparing donors
Penetrating Keratoplasty

Procedures

• TopHat

• Mushroom

• Zigzag
TopHat Shape

- for endothelial disease
- provides large endothelial surface transplantation
Mushroom Shape

- for anterior corneal disease
- preserves more host endothelium
ZigZag Shape

- hermetic wound seal
- angled edge provides smooth transition between host and donor
Zigzag
or “Z”
Roger Steinert
Surgeons

USA
• Frank Price
• William Culbertson
• Sonia Yoo
• Eduardo Alfonso
• Roger Steinert

EU
• Lucio Buratto
• Rudy Nuijts
• Thomas Neuhann
• Barbara Lege
• Markus Bauer
• E. Bohm
• L. Mosca
• Emilio Balestrazzi
• Ciro Tamburelli
• Sheraz Daya
Intralase Assisted PK Wounds
Separate Very Easily

So How Do We Make It Safe to Move Patients Between Facilities?
Non-Intersecting Cuts

First technique - easy separation but may not be strong enough

Very strong

Very strong, avoids bubbles in AC, may be difficult in corneas with thin areas

- Allow patients to be moved to an operating room
Why Does IEK Represent a Dramatic Change for PK?

• Precise incisions
  – No lamellar deflection
  – Applanation prevents bulging
  – Simple or complex incision patterns

• Reproducible
  – Patient to donor
  – Eye Bank to Dr’s incisions on patient

• Activation of keratocytes in discrete area
Trephines Can Lead to Distortion
Art Vs. Precision

Tendency for deviation in lamellar tissue depends on the angle of incidence – more oblique with increasing trephine diameter – if not perpendicular more deflection one side

Eye Surgery An Introduction, Georg Eisner 1980 Springer-Verlag
What Can We Do With Intralase That We Could Not Do With Mechanical Methods?
IntraLase Enabled Keratoplasty

Example Pattern Combinations
41 year old female
Tophat for herpetic scar
Sutures out 5 months
Cataract surgery 7 months, 1 week postop: -.75 sphere = 20/20
Ring Cut is always uniform depth from anterior surface
Manual PKP Alignment Marks

- Trephine is centered on the mark and the cornea is cut
Manual PKP Alignment Marks

• Perfect centration is critical to minimize torsional astigmatism
• It is impossible to perfectly align the marks in separate steps
Manual PKP Alignment Marks

- Donor tissue is aligned to the marks but it is torqued
- Induce irregular astigmatism and high order aberrations
Advantages of Alignment Incisions
Optimized X-Y Alignment

• Alignment Incision is created at the same time as the laser trephination

• Perfectly centered every time
What Does the Future Hold for Femtosecond Laser PK’s?

• Competition – more laser companies
• Decreased Astigmatism (?)
• More patterns - ? Ovals

• “Machine precision Vs. Hand crafted”

• USA may be moving towards eye bank prepared donor tissue
Endo-Stromal Transplant
Intacs-Keratoconus

Courtesy Jaime Martiz, M.D.
Ectasia and Riboflavin
Astigmatic Incisions

- Can be used for Astigmatic Keratotomy or Wedge Resection
Intralase for high astigmatism after Corneal Transplantation
Cataract Surgical Incisions

• Intraocular Lenses
  – Anterior and Posterior Chamber Phakic IOL’s
  – Pseudophakic IOL’s
Intracorneal Inlays
AcuFocus
Pinhole design, improve near images removing aberrations

ReVision
Hydrogel co-polymer

BioVision, Invue
Hydrogel

Slide courtesy Francisco-Leon Sanchez, MD
Thank You

Medicine consists of amusing the patient while nature cures the disease.
Voltaire

Experience is something I always think I have until I get more of it.
Dan Kaercer