I need to acknowledge Dr. Bill Tullo and Dr. Lou Probst who provided slides for this talk.

Surface Ablation Techniques. Suphi Taneri, MD, Michael Weisberg, MD, Dimitri T. Azar, MD Cataract Refract Surg 2011; 37:382–408 © 2011 ASCRS and ESCRS

<table>
<thead>
<tr>
<th>Factor</th>
<th>PRK</th>
<th>LASIK</th>
<th>EPI-LASIK</th>
<th>LASIK</th>
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</thead>
<tbody>
<tr>
<td>Range of correction</td>
<td>Low to moderately high</td>
<td>Low to moderately high</td>
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<tr>
<td>Postoperative pain</td>
<td>Mild to moderate</td>
<td>24–72 hours</td>
<td>Minimum 12 hours</td>
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<tr>
<td>Postoperative medications</td>
<td>1–3 months</td>
<td>1 week</td>
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<tr>
<td>Functional vision recovery</td>
<td>3 to 7 days</td>
<td>&lt;24 hours</td>
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<tr>
<td>Refractive stability achieved</td>
<td>3 weeks to 3 months</td>
<td>1 week to 3 months</td>
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<tr>
<td>Specific complications</td>
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<tr>
<td>Dry-eye syndrome</td>
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<td>Thin cornea or wide pupils</td>
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<tr>
<td>Special (relative) contraindications</td>
<td></td>
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<tr>
<td>Special (relative) indications</td>
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</table>

Contraindications for LASIK

- **Keratoconus**
  - Irregular Astigmatism
- **Monocular Patients**
  - Amblyopic patients must have BCVA 20/40 or better
- **Severe Dry Eye**
  - Exposure Keratopathy
- **Pacemaker**

Common Concerns

- **Pregnant/Breastfeeding**
  - 3 normal cycles and stable RX
- **Diabetes**
  - No retinopathy, stable RX, stable/low A1C
- **Autoimmune Conditions**
  - Concern about DES
  - Rheumatoid Arthritis = contraindication
- **HIV**
  - Need blood work

Common Concerns

- **Dry Eye**
  - No current symptoms, stable RX
- **Previous ocular Herpetic infection**
  - Some surgeons consider this an absolute contraindication
  - No occurrence for 6-12 months
  - Pre-treat with oral Acyclovir
- **Corneal Scar**
  - Consider PRK depending on placement
- **EBMD or Recurrent Corneal Erosion**
  - Consider PRK

Refractive Error

- Myopia
- Astigmatism
- Hyperopia
- Presbyopia
**Myopia**

**FDA Approval**
- LASIK: 1D – 14D
- PRK: 1D – 13D
- Intacs: 1D-3D
- ICL: 3D- 20D
- RLE/DLS: ANY

**Common Use**
- LASIK: 1D – 8D
- PRK: 1D – 6D
- Intacs: Not Used
- ICL: 8D- 26D
- RLE/DLS: ANY

**Myopic Astigmatism**

**FDA Approval**
- LASIK: 0.25D-6D
- PRK: 0.25D-6D
- Intacs: NONE
- ICL: NONE
- CLE/DLS: 0.00D-6D

**Common Use**
- LASIK: 0.25D-6D
- PRK: 0.25D-3.00D
- Intacs: NONE
- ICL: NONE
- CLE/CAT: 0.75D-6D

**Hyperopia**

**FDA Approval**
- LASIK: 0.25D-6D
- PRK: 0.25D-6D
- Intacs: NONE
- ICL: NONE
- RLE/DLS: ANY

**Common Use**
- LASIK: 0.25D-3D
- PRK: 0.25D-6D
- Intacs: NONE
- ICL: NONE
- RLE/DLS: ANY

**Hyperopic Astigmatism**

**FDA Approval**
- LASIK: 0.25D-6D
- PRK: 0.25D-6D
- Intacs: NONE
- ICL: NONE
- RLE/DLS: 0.75D-6D

**Common Use**
- LASIK: 0.25D-3D
- PRK: 0.25D-3D
- Intacs: NONE
- ICL: NONE
- RLE/DLS: 0.75D-6D
Mixed Astigmatism

FDA Approval

<table>
<thead>
<tr>
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<th>FDA Approval</th>
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<tr>
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Common Use

<table>
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<tr>
<td>LASIK</td>
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</tr>
<tr>
<td>PRK</td>
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<td>P-IOL</td>
<td>NONE</td>
</tr>
<tr>
<td>RLE/DLS</td>
<td>0.75D-6D</td>
</tr>
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</table>

Types of Corneal Ablation

- **Conventional Spherical treatment**
  - Induces significant spherical aberration
  - Rarely performed

- **Prolate – Wavefront-Optimized**
  - Age-related prolate pattern
  - Induce less spherical aberration compared to conventional ablations
  - Increase Quality of Vision

- **Contoura-Topographic Guided**
  - Uses patient’s topography guide treatment
  - Treats corneal asymmetry and normal irregularities
  - Increase Quality of Vision

- **Wavefront Guided – Custom**
  - Uses patient’s aberrometry to guide treatment
  - Induce less spherical aberration compared to conventional ablations
  - Increase Quality of Vision

FDA Approved LASERS

- Alcon – Allegretto
- B&L – Zyoptix
- AMO – VISX CustomVue
- Nidek – EC5000
- Zeiss- Meditec Mel 80
Mechanical Microkeratome

Still used in close to 40% of cases. I abandoned this technology in 2002 and never looked back.

Femtosecond Lasers

- Intralase
  ➢ iFS
- Ziemer
  ➢ LDV
- Femtec
  ➢ 2010 Perfect Vision
- Zeiss
  ➢ VisuMax
- Technolas
  ➢ Victus

Still used in close to 40% of cases. I abandoned this technology in 2002 and never looked back.
Comparison of Features: IntraLase® FS Laser and iFS™ Laser

IntraLase FS Laser
- Customization of all surgical parameters for circular flaps
- 15 to 20 second flap creation
- Clinical validation of biomechanical stability and wound healing
- Flap tensile strength 2x stronger than current microkeratome technology
- Clinically effective, extensively functional
- Optimal predictability and reliability
- User friendly
- IEK feature optional

New iFS Laser
- Advanced customization of surgical parameters including:
  - Inverted side cut architecture
  - Elliptical shape
- Flap creation in <10 seconds
- Ability to biomechanically design every flap
- Flap tensile strength 3x stronger than current microkeratome technology
- Contemporary, intuitive new GUI design
- Innovative hi-res digital surgical microscope
- IEK feature included


Corneal Nerves – Dry Eye

Dry Eyes
- Dry Eyes does not make any refractive procedure better.
- But it does make them contact lens failures, thus more likely to seek treatment!
- Severe Dry Eyes is a contraindication to any corneal surgical procedure.
- Dry Eyes should be treated before any surgical procedure.

Elliptical Flaps
- Preserves peripheral vital lamellar fibers

Dry Eyes
- Preserves peripheral vital lamellar fibers
Dry Eyes

- After Lasik, this reflex arc in interrupted over much of the cornea by making the flap, which severs the nerves about 160 μ deep in the stroma.
- This causes a decreased tear flow until the nerves regenerate, which can take months.

After Lasik, this reflex arc in interrupted over much of the cornea by making the flap, which severs the nerves about 160 μ deep in the stroma.

Dry Eyes

- Partial return of innervation will imply only a partial restoration of tear volume.
- If the tear volume is normal, the reserve tear production will be sufficient to maintain normal tear function.
- If the production of tears is borderline, the production of clinical dry eye syndrome by the surgery is possible, even likely.

Dry Eyes

- After the surgical procedure, the nerves began to regrow.
  - In PRK, the re-growth is usually complete within 3 months.
  - In Lasik, the re-innervation is frequently not complete at 6 months.
- The return of innervation in Lasik is frequently incomplete.

Dry Eye

- Thus, it is mandatory that every refractive surgery be evaluated preoperatively by an effective technique.
- This normally would include some of the following:
  - Dry Eye Questionnaire
  - Rose Bengal and/or Lissamine Green Staining
  - Tear Break-up time
  - Schimer’s Test or Zone Quick
  - Tear Lactoferrin and Lysozyme Assay
Advantages of Femtosecond Flap

- Independent specific diameter
- Independent specific thickness
- Better flap centration
- Variable hinge size/location
- Beveled edge
- Smooth evenly hydrated stromal bed
- Conserve tissue
- Planar shape

- **Safer**
  - Less complications
  - Less loss of BCVA
  - More gain of BCVA
  - Biomechanically stronger
  - Lower risk of keratectasia

- **Better Efficacy**
  - Induce less HOA
  - Smoother beds
  - Even hydration
  - Faster visual recovery
  - Better Low Contrast vision

Patient’s Experience

- Expectations for surgery day:
  - Mild oral sedative and numbing drops
  - Pressure feeling during flap creation
    - Vision may grey or black out
  - Burning smell 😞

Patient’s Experience

- Key points to discuss with your patients:
  - Risk of enhancement
  - **Presbyopia**
  - Use of antibiotic and steroid
    - Reduce the risk of infection and inflammation
  - Dry eye

LASIK Post-Operative Care

- Patient Instructions during Post Op:
  - For 1 week -
    - No Swimming or using hot tubs
    - No Makeup
    - No Sports
    - No Rubbing or squeezing the eye (some say 1-6 months)
    - Avoid dirty environments and wear sunglasses
    - Use the fox shield at night
    - Kick boxing and karate should wait 3 months
    - Scuba diving 1 month
**LASIK Post-Operative Care**

- **TYPICAL MEDICATION REGIMEN:**
  - Vigamox/Zymaxid qid X 1 week
  - Lotemax/FML/Pred Forte
    - q2h x 2 days
    - qid X 5-7 days
  - Artificial Tears qid X 1 month
  - Restasis bid when indicated
- **Protection of the flaps**
  - Fox shield QHS x 5-7 days
  - Sunglasses outdoors for 1 week
  - Limited physical activity

- **POST-OP EXAM SCHEDULE**
  - Day 1
  - Day 1-2 weeks
  - Months 1, 3, 6*, and 12*

- **Enhancements:**
  - Post op schedule the same as a primary procedure

**LASIK What to Look for at Each Post Op**

- **LASIK Post Op Examination:**
  - **Flap:**
    - Position: excellent, dislodged, striae, centered?
    - Clarity: clear, edema, haze?
    - Interface: clear, opacities, epithelial ingrowth?
    - Edges: smooth, rolled, eroded?
  - **Interface Material**
    - Debris
    - Epithelial cells/ingrowth
    - Diffuse Lamellar Keratitis (SOS)

**Day One Pearls - Critical Timing**

**CLINICAL TESTS**
- Celebration!!
- History
- UCVA OD/OS
- Slit lamp
  - Biomicroscopy
- Review drops / instructions
- RTO 3-5 days

**CLINICAL FINDINGS**
- Dislodged flap*
- Flap Striae*
- Infiltrate/Infection*
- DLK “SOS”
- SPK
- Poor UCVA

*Notify surgeon
5-7 Days Pearls - Critical Timing

CLINICAL TESTS
- History
- UCVA OD/OS
- Dry Refraction: BCVA
  • Only if UCVA < 20/20
- Slit lamp Biomicroscopy
- Instructions/Discontinue medications
- Patient reassurance
- RTO 3 weeks
- Resume most activities and make-up

CLINICAL FINDINGS
- Flap Striae*
- DLK “SOS”*
- Infiltrate/Infection*
- Epithelial ingrowth*
- SPK
- Refractive error
- Loss of BCVA*
*Notify surgeon

3,6,12 Month Post-op Pearls

CLINICAL TESTS
- History
- UCVA OD/OS
- Dry Rx BCVA at 3 month only (nomogram)
- Slit lamp biomicroscopy
- Instructions, RTO 3-6 months

CLINICAL FINDINGS
- Epithelial ingrowth
- SPK
- Refractive error
- Flap Striae*
- Loss of BCVA*
*Notify surgeon

1 Month Pearls - Critical Timing

CLINICAL TESTS
- History
- UCVA OD/OS
- Dry Rx BCVA only if UCVA < 20/20
- Slit lamp Biomicroscopy
- Instructions, RTO 2 months

CLINICAL FINDINGS
- Flap Striae*
- Epithelial ingrowth*
- SPK
- Refractive error
- Loss of BCVA*
* Notify surgeon

LASIK Post-Operative Care

Common Early Clinical Findings:

Visual recovery is quite rapid with LASIK – usually-
- 20/25 or better day 1
- VA varies with amount of myopic correction
- VA recovery is slower with Hyperopes
  – Takes one week to get to good VA, one month to get
to great VA (similar to PRK)
  – Usually No “wow” effect on the 1 day post op.
- Age, refractive error, and ocular surface
  conditions will also contribute to the healing rate
Subconjunctival Hemorrhages

Lint fibers under the flap will not cause an infection or visual problem. They will become inflamed during the 1st week from time to time, but don't have to be removed.

Epithelial Defect

Interface Debris

Neither are permanent
Neither cause a visual problem
Dry Eye Disease

Dry Eye - Most common Complication

➢ Cause:
  ▪ Disruption of corneal nerves = decreased tear production
  ▪ Goblet cell damage from pressure during flap creation
  ▪ Change in corneal curvature
    – Changes how the tear film covers the cornea
    – More significant in hyperopic treatments


Dry Eye – Most common Complication

➢ 85% at 1 week post-op
➢ 60% at 1 month post-op
➢ 11.3% at 3 months post-op
➢ Return to baseline by 12 months

2- Schallhorn – Optical Express Data

Dry Eye Treatment

➢ Artificial tears at least qid (1-6 months)
  ▪ Patients present for post-op visits with a white conjunctiva and no signs of dryness, but they complain of blurry vision or halos and glare.
  ▪ The patients are unaware of the irritation to the corneal surface because of the temporary neurotrophic effect of Lasik.

➢ Punctual occlusion
  ▪ Extended duration collagen plugs

➢ Treat MGD
  ▪ Best to pre-treat before surgery
  ▪ Omega 3 Fish Oil vitamins

➢ Cyclosporine 0.05 % (Restasis)
Complications to watch for...

- Wrinkling of the flap
- Epithelial ingrowth
- Diffuse Lamellar Keratitis (DLK) Stage 4
- Bacterial keratitis
- Post-Lasik/PRK: Consider Fortified Vancomycin

Patient RS

- 31 year old male
- 12 hours S/P uneventful LASIK OU
- Patient phones with complaints of discomfort OU
- “My right eye became very uncomfortable about an hour after I got home and the vision is much better currently in my left eye.”

When should patient RS return to the clinic?

- Immediately
- Diagnosis: Wrinkled/Dislodged/Slipped Flap
- Plan:
  - Return to surgeon to lift and smooth flap
  - Can temporarily place a bandage contact on the eye
Patient AB

- 25 year old female
- 1 week S/P bilateral LASIK
- Painless reduced VA in left eye since surgery
- "My vision just isn’t as good out of my left eye as I hoped it would be. I am seeing a lot of glare at night."

What test would you perform on patient AB at the 1 week post op visit?

A. UCVA OD and OS
B. Refraction and BCVA OD and OS
C. Slit lamp biomicroscopy
D. **Tonometry**
E. Dilate pupil
F. **Fluorescein**

Differential Diagnosis at 1 week

- Flap Striae
- SPK/DES
- Residual refractive error
- DLK
- Infection (expect pain)
- Epithelial ingrowth (very rare)

Flap Striae

Easier to see in retroillumination over the pupil
Flap Striae

- Flourescein makes it easier to see as valleys and mountains differentiate with negative staining

Flap Microstriae

- Often not visible at 1-day check
- Onset 24-72 hours
- Will NOT resolve without treatment
- Common with high myopia
- Common with deep ablations
- Usually find small amounts of mixed astigmatism
- Only significant if have a loss of BCVA or a subjective complaint in the quality of vision (night glare/halo)

Flap Striae Treatment

- If treatment is necessary:
  - Caroball smoothing
  - Flap lift and stretch
  - Flap suture
  - Flap excision
- The sooner the better
Patient MN

- 25YOM 5 days S/P bilateral Lasik
- “My right eye hurts and is sensitive to the light. My vision is getting blurry in the right eye. My left eye feels fine.”
- When should you see this patient?
  ➢ Immediately

Hopefully never gets this bad...
Presumed Infectious Keratitis:

- Call your Refractive Surgery Center!!!
- Increase antibiotic (Zymaxid q1h)
- Add fortified antibiotic (Vancomycin)
- D/C Steroid
- Lift flap and culture
- Follow daily until resolution
  ➢ (1-2 visits per day)
- Long-term
  ➢ Flap smoothing
  ➢ PTK
  ➢ Flap removal
  ➢ PK

What tests would you perform on TS at the 1 month PO visit?

A. UCVA in OD and OS
B. Refraction and BCVA in OD and OS
C. Slit lamp biomicroscopy OU
D. NaFl instillation OU
E. Tonometry OU (only if necessary)
F. Corneal topography OU (only if necessary)
G. Wavefront Aberrometry (only if necessary)

Patient TS

- 42 year old male
- Right eye is sore to the touch since LASIK enhancement 1 month ago
- Vision has declined in the right eye over the past week
Diagnosis?

▪ Epithelial ingrowth

What are good reasons to treat Epithelial ingrowth?

▪ Epithelial cells within pupil with decreased BCVA
▪ Persistent flap edge staining with NaFl
▪ Progressive refraction or topographic changes
▪ Flap melt
▪ Persistent sore eye
▪ Day time glare symptoms

*The majority of epi ingrowth does not need to be treated*

Patient CC

▪ 40 year old female
▪ S/P bilateral LASIK x 1 week
▪ Patient reports a mild scratchy feeling that is getting worse.
▪ Slitlamp biomicroscopy reveals “cloudy haze in right cornea”
**Diffuse Lamellar Keratitis (DLK)**

- Begins in the periphery in the flap interface
- Looks like white “sand” particles
- Typically unilateral
- Tend to occur in outbreaks/sequential patients
- Looks like whitish sand underneath the flap
- Typically noted at day 1 or week 1 postoperative exams
- Can have late onset
  - Even years later, particularly after corneal trauma

**Etiology: Unknown?**
- Bacterial endotoxins in the autoclave reservoirs
  - Contaminated sterilizer reservoir
- Excessive corneal manipulation
- Mold or fungal contamination
- Trauma
- Excessive Intralase energy (Unlikely with current Intralase)
- Poor manufactured blades (Rarely used anymore)
- DLK is much less common now due to proper sterilization and disposable instruments.
### DLK Grade 2

| Signs/Symptoms | Diffuse, white/gray, granular material in the flap interface  
|                | Normal VA or reduced 1–2 lines  
|                | Mild discomfort |
| Treatment      | Increase topical steroids q1h  
|                | Interface irrigation (return to surgeon)  
|                | f/u every day |
| Prognosis      | Excellent after interface irrig |

- IOP must be closely monitored during steroid treatment  
- If IOP ↑ Change to a “softer” steroid and add Glaucoma medications  
- Steroids are **not** discontinued

### DLK Grade 3

| Signs/Symptoms | Diffuse, confluent, white/gray, granular material in the flap interface  
|                | Significantly reduced BCVA (hyperopic astigmatism)  
|                | Discomfort and possible conj injection |
| Treatment      | Should not get to this stage  
|                | Increase topical steroids q1h  
|                | Interface irrigation!! (return to surgeon)  
|                | f/u every day |
| Prognosis      | Good after interface irrigation |

- IOP must be closely monitored during steroid treatment  
- If IOP ↑ Change to a “softer” steroid and add Glaucoma medications  
- Steroids are **not** discontinued
### DLK Grade 4

| Signs/ Symptoms | - Diffuse, confluent, white/gray, granular material in the flap interface  
|                 | - Intense central inflammation  
|                 | - Significantly reduced BCVA (hyperopic astigmatism)  
|                 | - Discomfort and possible conj injection |

| Treatment | - Should not get to this stage!!!  
|           | - Increase topical steroids q1h  
|           | - Interface irrigation!! (return to surgeon)  
|           | - f/u every day |

| Prognosis | - ?? Possible reduced BCVA, irregular astigmatism, residual hyperopia |

Thank You!