XXIX Congress of the European Society Of Cataract And Refractive Surgery

17-21 September 2011
Vienna, Austria

Course IC 41

“Refractive Surgery Nightmares: Management And Prevention Of The Most Horrible Complications”

Senior Instructor:
Marguerite B McDonald MD

Instructor:
Dan Epstein MD
Richard L Lindstrom MD
Matteo Piovella MD
Donald N Serafano MD
Paolo Vinciguerra MD

Sunday, Sept 18, 2011
2.30 PM – 4.30 PM
# Index

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction 1990: History of Multiple Optical Zone and PRK Nightmares</td>
<td>4</td>
</tr>
<tr>
<td>Matteo Piovella MD</td>
<td></td>
</tr>
<tr>
<td>Doc, I want both eyes done at the same time</td>
<td>6</td>
</tr>
<tr>
<td>Matteo Piovella MD</td>
<td></td>
</tr>
<tr>
<td>&quot;I wish I would have never treated this patient&quot;</td>
<td>7</td>
</tr>
<tr>
<td>Matteo Piovella MD</td>
<td></td>
</tr>
<tr>
<td>Refractive surgery in patients with vision reduced by other problems</td>
<td>7</td>
</tr>
<tr>
<td>Matteo Piovella MD</td>
<td></td>
</tr>
<tr>
<td>Irregular astigmatism after RK: retreatment with TOSCA customized ablation</td>
<td>8</td>
</tr>
<tr>
<td>Matteo Piovella MD</td>
<td></td>
</tr>
<tr>
<td>Lasik Complications: Sands Of The Sahara</td>
<td>8</td>
</tr>
<tr>
<td>Matteo Piovella MD</td>
<td></td>
</tr>
<tr>
<td>A New Solid State Uv Laser For Refractive Surgery</td>
<td>13</td>
</tr>
<tr>
<td>Matteo Piovella MD</td>
<td></td>
</tr>
<tr>
<td>Diffuse Interlamellar Keratitis</td>
<td>15</td>
</tr>
<tr>
<td>Marguerite B McDonald MD</td>
<td></td>
</tr>
<tr>
<td>Diffuse Lamellar Keratitis</td>
<td>16</td>
</tr>
<tr>
<td>Richard L Lindstrom MD</td>
<td></td>
</tr>
<tr>
<td>Epithelial Defects related to LASIK</td>
<td>18</td>
</tr>
<tr>
<td>Donald N Serafano MD</td>
<td></td>
</tr>
</tbody>
</table>
Microkeratome problems and solutions

Donald N Serafano MD

Methicillin-Resistant Ocular Infection

Donald N Serafano MD

Decentration after Refractive Surgery

Paolo Vinciguerra MD

Prevention of corneal ectasia in Laser in Situ Keratomileusis

Paolo Vinciguerra MD

ADDRESS
“Introduction 1990: History Of Multiple Optical Zone And Prk Nightmares”
Matteo Piovella MD

Nightmares: experience, situation or object producing a feeling of anxiety (Webster’s)

High myopia patient: a portrait
- Personality influenced from myopia
- Living high myopia as an handicap
- With profound desire to reduce myopia

How do they perceive Laser treatment?
- Laser preventing evolution of myopia
- Laser preventing complications typical of high myopia

Education
- Knowledge of possible complications
- Discuss about the future: presbyopia

Patients with high myopia just want….to be less myopic
Laser Refractive Surgery: what happens in years?

Originally designed technique (1990)
Criteria
- Increased optical zone diameter
- Multiple optical zones (4.0, 5.0, 6.0 mm)
- Steps of similar height

Large optical zone (1990!)
Limits
- Homogeneous laser beam
- Adequate laser power
- Accurate control of laser parameters and efficiency

Technique
- Step height: less than 43 microns
- Maximal difference between steps: 8 micron
- Maximal total ablation: 121 microns

1990 – 1994
- 56 eyes
- 44 patients (26 men, 18 women)
- age: 32 ± 8 y.o.
- follow up*: 26 ± 14 mos.
  *= (mean ± S.D.)

Inclusion Criteria
- age > 20 y.o.
- contact lens intolerance
- corneal pachimetry > 450 micron
- myopia > 5.50 D

Preoperative refraction
- -11.3 ± 4.5 D (mean SE ± S.D.)
- range: -5.75 to −24.50 D

Aimed myopia reduction
- -9.44 ± 3.2 (mean SE ± S.D.)
<table>
<thead>
<tr>
<th><strong>Final Refraction (with retreatments): 56 eyes</strong></th>
<th><strong>Patient Satisfaction</strong></th>
</tr>
</thead>
</table>
| Achieved 95.2% of attempted correction | • questionnaire  
• 31 patients, 41 eyes  
• satisfaction evaluated for each single eye  
32.1 ± 10.9 months after surgery |

<table>
<thead>
<tr>
<th><strong>Glare - Halos - Night Vision Impairment</strong></th>
<th><strong>Patient Satisfaction</strong></th>
</tr>
</thead>
</table>
| single zone: glare in 43.0% of cases after 1 yr.  
*(Seiler T - Ophthalmology 1994; 101)*  
Two zones: night vision impairment in 70% of cases at 6 months  
*(Kim JH – Refract Corn Surg 1993; 9 (suppl.))*  
*night vision impairment is reduced with a wide optical zone* | • Halos 51.2 %  
• Night driving problems 47.4 % |

<table>
<thead>
<tr>
<th><strong>Patient Satisfaction</strong></th>
<th><strong>Patient Satisfaction</strong></th>
</tr>
</thead>
</table>
| • Decrease of symptoms with time 73.2 %  
• Pleased with results 92.7 % | • High patient satisfaction (32 ± 10.9 months)  
• positive opinion toward treatment of fellow eye :87.1% |

<table>
<thead>
<tr>
<th><strong>What’s behind the Corner?</strong></th>
<th><strong>What’s behind the Corner?</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Some eyes show haze, regression, scarring...</td>
<td>Are they just like successfully treated eyes?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Extraocular Factors Probably Influencing the Results of PRK</strong></th>
<th><strong>PRK: 463 eyes</strong></th>
</tr>
</thead>
</table>
| Giovanni Fumagalli, M.D.  
*Bergamo - Italy* | 8% (n=37) of eyes with 8 or > D showed:  
important regression + haze + scarring |

| **Highly myopic patients represent a difficult problem** | **Excimer PRK for moderate and severe myopia allows consistent, stable and satisfactory (even if not perfect) results on a long-term basis.** |
“Doc, I Want Both Eyes Done At The Same Time”
Matteo Piovella MD

The decision belongs to the Ophthalmologists...

But if treatment should be bilateral the Patient must thoroughly share the choice

Bilateral Treatment? Bilateral Complication!!

<table>
<thead>
<tr>
<th>Bilateral Complication</th>
<th>Bilateral Complication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dramatic if...</td>
<td>Unilateral complication:</td>
</tr>
<tr>
<td>• Diffuse interlamellar keratitis (SOS)</td>
<td>Unhappy patient</td>
</tr>
<tr>
<td>• Epithelialization</td>
<td>Bilateral complication:</td>
</tr>
<tr>
<td>• Haze</td>
<td>Very unhappy, very aggressive patient</td>
</tr>
<tr>
<td>• Unpredictable postoperative reaction (i.e. steroid reponder)</td>
<td></td>
</tr>
<tr>
<td>• Important regression</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bilateral Complication</th>
<th>Bilateral Complication</th>
</tr>
</thead>
<tbody>
<tr>
<td>When to avoid bilateral surgery</td>
<td>Unilateral Vision Severe Loss:</td>
</tr>
<tr>
<td>• Limited experience with a technique</td>
<td>30% disability</td>
</tr>
<tr>
<td>• During a period of technical evolution</td>
<td>Bilateral Vision Severe Loss:</td>
</tr>
<tr>
<td>• With psychologically delicate patient</td>
<td>100% disability</td>
</tr>
<tr>
<td>• Very demanding patient</td>
<td></td>
</tr>
</tbody>
</table>

Avoid to talk the patient into bilateral surgery

<table>
<thead>
<tr>
<th>Bilateral Treatment</th>
<th>Bilateral Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Means:</td>
<td>Patients with a complication in one eye...</td>
</tr>
<tr>
<td>Losing the time interval that one treated eye</td>
<td>Wait a looong time before having surgery</td>
</tr>
<tr>
<td>may need for stabilization</td>
<td>on the fellow eye</td>
</tr>
</tbody>
</table>

Unilateral Vision Severe Loss: 30% disability

Bilateral Vision Severe Loss: 100% disability
Against all odds...

I have treated both eyes on a patient. And he has a complication.

And now WHAT?

For the Ophthalmologists:
- Do not look for improptu solutions
- Group therapy: ask for suggestion to a colleague with more experience
- Exchange opinions (to decrease anxiety)
- Look for colleagues with experience in the problem

For the Patient:
- Target: do not lose the patient
- Dedicate time
- Customized management
- Do not live control examination time as a nightmare
- He/she is a patient that needs help

Unilateral Treatment

Information on postoperative behaviour of first eye (haze, regression, patient satisfaction, halos)

is always determinant for treatment strategy in the second eye

Helping our Patients is Helping Ourselves

If you feel you cannot manage the case, do not hesitate to refer to a more experienced Ophthalmologist

“I Wish Would Have Never Treated This Patient... Treating The Wrong Patient”
Matteo Piovella MD

Refractive defect: is a disease?

Myopia is less perceived as a disease
Then, i.e., cataract

Patients often unconsciously deny refractive surgery is real surgery

Avoid:
- Depressed patients
- Patients assuming psyco-drugs
- Patients that do not listen
- Patients that have a “magic attitude towards refractive surgery

Defence Line
- Accurate patient selection
- Golden number of excluded patients: 20%-40%
- Do not treat them
- Standardized Informed Consent
Question-and-answer Informed Consent
“Irregular Astigmatism After Rk: Retreatment With Tosca Customized Ablation”  
Matteo Piovella MD

---

**Excimer Ablation on RK eyes**
- Considered very dangerous by many surgeons due to central corneal haze originating from RK incisions
- In our opinion this is true for deep ablations Customized ablations regularize corneal surface and require little tissue removal

---

**TOSCA Ablation after RK (20 cases)**
- BCVA pre-op (mean): 0.48
- BCVA post-op (mean): 0.69
- SE pre-op (mean): -0.63 D
- SE post-op (mean): -0.27 D
- Ast. Pre-op (mean): 2.8 D
- Ast. Post-op (mean): 1.5 D

---

**Materials and Methods**
- 20 RK eyes
- Follow-up: 3 to 16 yrs (mean 9.33 yrs)
- Customized ablation with TOSCA link and Meditec MEL 70 Excimer Laser

---

**Conclusions**
- Results in these difficult cases have been fairly good
- Postoperative haze ranged from 0 to 1 and disappeared within 2-3 months
- In some cases we adopted a cautious approach, limiting the amount of ablation
- Probably the new MEL 80 will give us even better results

---

“Lasik Complications: Sands Of The Sahara”  
Matteo Piovella MD

---

**PRK**
**Glare – Halos – Night Vision Impairment**
- Single zone: glare in 43% of cases after 1 yr (Seiler T – Ophthalmology 1994; 101)
- Two zones: night vision impairment in 70% of cases at 6 months (Kim JH – Refract Corn Surg 1993; 9 (suppl))
  - night vision impairment is reduced with a wide optical zone

---

**Patient satisfaction (personal experience)**
- Decrease of symptoms with time: 73.2%
- Pleased with results: 92.7%
**LASIK just like topical anesthesia**
- More liked by the patient
- More intraoperative problems

**First cases**
- 107 eyes
- 60 patients
- Preoperative refraction: 
  \[-6.7 \pm 3.9\ D\]

**Intraoperative complications**
- Surgeon’s vision at the microscope is coaxial
- Slit lamp examination before discharge is mandatory: the only way to visualize inclusions

**Inclusions**
- Inclusions: n=4
- Flap striae: n=4

**Inclusions: prevention**
- Correct surgical field preparation
- Eyelid draping
- Powder-free gloves
- Lint-free drapes (no tissues)
- Repeated, *Niagara* washing
- Complete conjunctival rinsing
- No haircut the day before

**Microkeratome-related complications**
- Free cap: n=0
- Incomplete flap: n=0
- Irregular flap: n=0

**Microkeratome-related complications: Prevention**
- Accurate control of suction system
- Safety system check
- Accurate cleaning of the motor-side surface (Sahara’a sands)
- Wetting suction ring

**Microkeratome-related complications: Microkeratome testing**
- Engagement with suction ring
- Speed
- Back and reverse motion
- Motion smoothness
- Correct stop
- Down-up technique
- Single-piece microkeratomes
- Wetting suction ring
Microkeratome-related complications: Management

- Correct corneal marking repositioning

Sands of Sahara: Term introduced by Kerry Assil, California

Synonyms:

Diffuse Interlamellar Keratitis

Diffuse Lamellar Keratitis

Interface Keratitis

Diffuse Interface Keratitis

Non-specific Diffuse Interface Keratitis

Onset

- 2-5 days postoperatively
- if bilateral surgery, often 1st eye affected

Characteristics

- Confined to interface
- Diffused and scattered through a large area
- Multiple faint foci
- Infiltrates more concentrated around surgical debris
- Little/anterior chamber reaction
- No overlying epithelial defect (Smith & Maloney, Ophthalmology, 1998; 105:1721-1726)

Etiology

- Unknown
- Allergic or toxic reaction

Etiology

- Chemotactic factors
- Leukocytes from limbal vasculature attraction from chemotactic factors
Etiology Multifactorial
- Epithelial toxicity
- Flap epithelial abrasion
- Endogenous material: meibomian secretions, red blood cells, epithelium
- Exogenous toxins: talc, oil, instrument milk, NSAID, microkeratome blades
- Bacterial exotoxin/endotoxin of SoS: bacterial exotoxins/endotoxin

(Doane JF)

Etiology Multifactorial
- Oil
- Wax
- Metallic fragments
- Silicates
- Betadine
- Bacterial endotoxins
- Epithelial defects
- NSAID drops
- Laser/contamination interaction
- Others

(Lindstrom RL)

Sands of Sahara: theory
- After several procedures on the same day
- Fluid percolation from engine down to blade
- Blade heats stromal bed
- Chemical reaction
- Aseptic necrosis

Sands of Sahara
No known pathology
Incidence:
- 1:200 - 1:1000
  occurrence in clusters

Sands of the Sahara
Diagnosis
- Dusting of creamy colored leukocytes
- In the interface
- Initially peripheral
- Later diffuse

Sands of the Sahara
Differential Diagnosis
- Infectious keratitis
  Epithelial ingrowth (no pain)

Sands of the Sahara
Diagnostic Strategy
- Identifying cells in lamellar surface
- Staging their location and severity
- Intervening at appropriate time

(Lindstrom RL)

Staging (Lindstrom)
- Stage 1: white, granular cells in periphery
- Stage 2: white, granular cells in center of flap
- Stage 3: dense, white, clumped cells in central visual axis
- Stage 4: stromal melting, permanent scarring, visual morbidity
**Classifications (Machat)**
- **Grade 1**: mild – vision unaffected
- **Grade 2**: like moderate PRK haze – BCVA reduced
- **Grade 3**: dense central infiltrate – decreased BCVA several lines

**Classifications (Hatsis)**
- **Grade I.** partial interface, no topographic change, excellent vision
- **Grade II.** complete interface, topographic changes, vision still excellent
- **Grade III.** + foggy vision
- **Grade IV.** + injection, lid edema, a/c cells

---

**Sands Of The Sahara: Personal Experience**

8 eyes – 5 patients
- All first treatments
- Mean patient age: 28.5 ± 8.6 yrs.
- BCVA: 20/21.2 ± 2.3
- Correction (SE): -5.3 ± 3.8 sph

8 eyes – 5 patients
- Onset: 2.6 ± 2.0 days after surgery
- BCVA: 20/37.5 ± 10.0

**Grading:** 2 - 3 of Machat

**Treatment:**
- Dexamethasone-heparin eyedrops
- Lomefloxacin eyedrops
- For a mean of 27.8 ± 4.0 days

**Follow-up:**
- 248 ± 137 days
- BCVA 20/23.1 ± 3.7
- SE +0.3 ±1.3 sph

**Case history: a retreatment**
- 41 y.o man
- BCVA preop 20/30 –11.00 –3.00 (10)
- Surgery: 10/07/98
- BCVA postop: 20/30 +4.00 –2.50 (85)

**Case history: a retreatment**
- On 03/16/2000:
  - 1\textsuperscript{st} day postop: BCVA 20/30 no correction

**Case history: 6 days postop**
- BCVA 20/63
- Put on standard treatment

**Case history: 2 months postop**
- BCVA 20/40 –0.50 sph
### Sands of the Sahara

#### Management
- Topical steroid (desamethasone ointment)
- Topical antibiotic (fluoroquinolone)
- Strict follow up

#### Prevention
- Accurate cleaning of microkeratome
- ?

### Conclusions

New microkeratomes reduce complications, anyway LASIK remains...

a territory to be explored!

LASIK patients need to be strictly monitored in the postoperative period.

### “A New Solid State Uv Laser For Refractive Surgery”

*Matteo Piovella MD*

*This device is not FDA approved*

**LASER SOFT (Katana Technologies GmbH, Germany)**

- Laser radiation wavelength: 210 nm
- Cw-diode-pumped all-solid-state UV Laser
- Very stable shot-to-shot
- High long-term UV output stability

- Excellent UV light spot distribution on the cornea
- Accurate overlap of true gaussian spot
- Extremely homogeneous corneal surface
- Flying spot of 0.25 mm indiameter
- Operating at repetition rate of 1 KhZ

---

**Lasersoft and custom ablation**

It’s very small spot size fits the present requirements for effective custom ablation

**Ablation algorithm**

- Adopted ablation profiles designed to preserve the strongly aspherical feature of normal cornea
- This to minimize induced spherical aberration
- Different reflection losses and fluence values for different angles of incidence of the ablating laser radiation are taken into account
### Solid-state UV Laser

Applying less energy to the cornea, this solid-state UV laser appears as a promising solution for a refractive surgery, thus with the potential of inducing less scarring due to a more homogeneous treatment.

- Less surgical performance variability
- No gas exchange/discharge
- No instabilities in the output radiation due to the discharge process
- Solid-state UV Laser approach and diode pumping system features long lifetime and efficiency
- Reduced maintenance requirements and related costs

### Preliminary clinical data - Preoperative

- SE refractive defect: \(-2.53 \pm 3.21\) D
- Sphere: \(-2.32 \pm 2.90\) D
- Cylinder: \(-0.43 \pm 1.33\) D

### Preliminary clinical data - Postoperative

- SE refractive defect: \(-0.27 \pm 0.36\) D
- Sphere: \(-0.24 \pm 0.30\) D
- Cylinder: \(-0.06 \pm 0.41\) D

### SE refractive defect, attempted vs. obtained:

\[-0.27 \pm 0.36\] D

### Preliminary clinical data

- 22 eyes of 19 patients
- age (mean + SD): 38 ± 13 yrs
- 12 PRK, 10 LASIK

### Preliminary clinical data - Preoperative

- SE refractive defect: \(-2.53 \pm 3.21\) D
- Sphere: \(-2.32 \pm 2.90\) D
- Cylinder: \(-0.43 \pm 1.33\) D

### Solid-state UV Laser

- Eye-tracker with a 1 ms latency
- Monitoring the ablation centration at very high repetition rates
- Reliable, high repetition rate centration of ablation
- On the x-y axes as well as the ocular rotation

### Preliminary clinical data - Postoperative

- SE refractive defect: \(-0.27 \pm 0.36\) D
- Sphere: \(-0.24 \pm 0.30\) D
- Cylinder: \(-0.06 \pm 0.41\) D

### Preliminary clinical data

- 22 eyes of 19 patients
- age (mean + SD): 38 ± 13 yrs
- 12 PRK, 10 LASIK

### Solid-state UV Laser

- High repetition rate (1 KhZ)
- Lower energy per pulse than in standard excimer treatments
- Ablation with strongly reduced stress waves
- No audible sound due to ablation or laser firing
- Treatment in a silent, patient-reassuring environment
- No sudden patient movement as laser starts
**Preliminary clinical data - Postoperative**

- SE refractive defect: -0.27 ± 0.36 D
- Sphere: -0.24 ± 0.30 D
- Cylinder: -0.06 ± 0.41 D

**SE refractive defect, attempted vs. obtained:**
-0.27 D ± 0.36 D

**Solid-state UV Laser -Safety**

- BSCVA pre-operative: 0.80 ± 0.23
- BSCVA post-operative: 0.83 ± 0.23

**Conclusions**

A safe, reliable, stable, more compact and less costly alternative to gas-operating excimer lasers for refractive surgery

---

**“Diffuse Interlamellar Keratitis”**

*Marguerite B McDonald MD*

Diffuse lamellar keratitis (DLK) is also known as "Sands of Sahara Syndrome". It is a well known hough poorly understood complication of LASIK. Diffuse lamellar keratitis appears an undulating pattern of white blood cells at the interface, usually appearing during the first 24 to 48 hours. DLK appears to have several different possible causes: bacterial endotoxins left behind in the autoclave if the reservoir has not been drained after the day's cases are finished; meibomian gland secretions; foreign bodies from the microkeratome or the drape material; cytokines from crushed epithelial cells; the presence of epithelial defects on the flap; and possibly epithelial ingrowth. There are other possible causes which have been debated by the experts, but these are considered to be the most likely causes.

It is important to stage DLK, as this dictates how it is treated.

* **Stage One** is a peripheral infiltration of white blood cells in a very fine and diffuse pattern; they have not yet layered into the undulating pattern (the classic "Sands of Sahara" picture). The visual axis is not yet affected in Stage One, and the DLK may even occur in only one small patch or in one quadrant. The treatment for Stage One is very heavy topical steroids (Prednisolone acetate or Decadron every hour while awake) with followup at 24 hours.

* **Stage Two** is very similar to Stage One except that the central cornea is involved. The treatment is the same as in the Stage One, with followup at 24 hours and daily until the DLK begins to resolve.

* **Stage Three** is characterized by a denser infiltration in the classic "Sands of Sahara" pattern. Visual Acuity is reduced and the patient may complain of a general haze to his/her vision. The treatment is immediate rinsing of the interface with sterile BSS, followed by topical Prednisolone acetate or Decadron drops every hour while awake. The patient should be seen on a daily basis to insure that the DLK is resolving.

* **Stage Four** is characterized by extremely heavy infiltration and scarring at the interface, with a marked loss of vision. Although rinsing is advisable if the patient is diagnosed within the first seven to ten days. Usually there is residual haze and irregular astigmatism.
which will result. Often, there is a marked hyperopic shift as well, as stromal tissue has been destroyed by collagen masses. These patients may require a heavily tinted rigid gas permeable contact to see without glare, and may actually require a penetrating keratoplasty if the loss vision is severe enough. Some patients may be treated at a later date with a customized ablation.

In Stages Three and Four oral steroids may sometimes be used if it appears that the DLK is returning after the rinsing procedure, and in spite of heavy topical steroids. Usually 80 mg of Prednisone taking daily for five to seven days with a rapid taper (accompanied by Zantac 150 mg po bid) will ensure that the DLK does not return.

“Diffuse Lamellar Keratitis”

Richard L Lindstrom MD

LASIK 26 yo FEMALE
- -2.00 sphere OU
- Uncomplicated LASIK
- Day 1- Stage 1 DLK
- PF q 1h WA, FML ointment at hs

1 month postop
26 yo female
- UCVA 20/20 OU
- No residual scar or irregular astigmatism

LASIK
52 years old Male
- -6.25 *1.50 x 90 OU
- LASIK without complication
- Day 1 – VA sc 20/25 OU
Stage 1 DLK OU began PF q 1 hr WA
- Day 5 – va sc 20/25 OD, 20/20 OS
Stage 4 dlk OD- began oral Prednisone 60 mg/day
**CLINICAL PRESENTATION**
- Appears on first day postoperatively
- White or tan cellular infiltrate typically aligned in rows or waves in interface
- Begins in flap periphery and moves centrally
- In bilateral simultaneous surgery, tens affect eye treated first most severely or exclusively (but not universal)

**STAGING**
- GRADE 1 Granular cells in periphery of flap sparing visual axis
- GRADE 2 Granular cells in central area of flap involving visual axis
- GRADE 3 Aggregation of cells in center with clumping: may clear peripherally
- GRADE 4 Corrugated "mud crack" appearance with stromal melting

**MANAGEMENT**
- **DLK**
  - Topical steroids for stage 1 and 2
  - Interface irrigation for stage 3
  - Prevent stage 4
  - Typically will prevent visual morbidity

**STAGE 1-2**
- Frequent topical steroids (e.g. Pred Forte q 1h, FML ung qhs)
- Tends to peak day 2-4, then slowly clear

**STAGE 3**
- Lift flap, irrigate, wipe with moist Merocel
- Do not scrape
- Continue frequent topical steroids

**PREVENTION**
- **DLK**
  - Keep microkeratome motor clean
  - Clean/irrigate blades
  - Talc free gloves
  - Irrigation of interface
  - Nightly siphoning and drying of sterilizer

**SUMMARY**
- **DLK after LASIK**
  - Be aware of potential complications
  - Early identification of DLK is key
    - If unsure- see on day 3
    - Irrigate on day 3 or 4
“Epithelial Defects Related To Lasik”
Donald N Serafano MD

**Preoperative evaluation**
- Dry eye syndrome
- Keratoconjunctivitis sicca
- Contact lens failure
- Poor eyelid closure
- Meibomian gland dysfunction
- Collagen-vascular disease

**Preoperative evaluation**
- Blepharitis
- Recurrent erosions
- Previous corneal surgery or trauma
- Contact lens wear
- Map dot corneal dystrophy
- Known anterior basement membrane disease

**Preoperative treatment**
- Discontinue contact lenses
- Artificial tears
- Lubricating ointments
- Punctal plugs
- Treat meibomian gland dysfunction and blepharitis

**Surgical considerations**
- Topical anesthetic immediately preoperative
- “push” test
- Lubrication of cornea prior to microkeratome placement
- Change to PRK

**Postoperative treatment**
- Bandage contact lens
- Pressure patch
- Artificial tears
- NSAIDS
- Many postoperative visits

**Postoperative considerations**
- Increased risk of epithelial ingrowth
- Increased risk of DLK
- Prolonged recovery
- Delay of fellow eye surgery
- Punctal plugs or punctual occlusions
"Microkeratome Problems And Solutions"
Donald N Serafano MD

**MICROTECH**
**LSK ONE NOMOGRAM**
*Courtesy of Dr. Michael Belin M.D., Albany NY*

*Vacuum Ring And Stop Ring Selection*
*Selection based on HORIZONTAL K reading*

<table>
<thead>
<tr>
<th>Desired OZ</th>
<th>K&lt;=39</th>
<th>39&lt;K&lt;=41</th>
<th>41&lt;K&lt;=43</th>
<th>43&lt;K&lt;=46</th>
<th>46&lt;K</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.0mm</td>
<td>-1/7.0</td>
<td>0/7.0</td>
<td>+1/7.0</td>
<td>+2/7.0</td>
<td>N/A</td>
</tr>
<tr>
<td>8.5mm</td>
<td>0/7.0</td>
<td>+1/7.0</td>
<td>+2/7.0</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>9.0mm</td>
<td>-1/7.5</td>
<td>0/7.5</td>
<td>+1/7.5</td>
<td>+2/7.5</td>
<td></td>
</tr>
<tr>
<td>9.5mm</td>
<td>H/8.0</td>
<td>-1/8.0</td>
<td>0/8.0</td>
<td>+1/8.0</td>
<td></td>
</tr>
<tr>
<td>10.0mm</td>
<td>H/8.5</td>
<td>-1/8.5</td>
<td></td>
<td>0/8.5</td>
<td></td>
</tr>
<tr>
<td>10.5mm</td>
<td></td>
<td>H/9.0</td>
<td></td>
<td>-1/9.0</td>
<td></td>
</tr>
</tbody>
</table>

**CARRIAZO-BARRAQUER NOMOGRAM**
*Courtesy of Dr. Cezar Carriazo M.D., Colombia*

*Vacuum Ring Selection*
*Selection based on K reading in the AXIS of where your HINGE is placed*

<table>
<thead>
<tr>
<th>Desired OZ</th>
<th>K&lt;=39</th>
<th>39&lt;K&lt;=41</th>
<th>41&lt;K&lt;=43</th>
<th>43&lt;K&lt;=46</th>
<th>46&lt;K</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.0mm</td>
<td>0</td>
<td>+1</td>
<td>+2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.5mm</td>
<td>-1</td>
<td>0</td>
<td>+1</td>
<td>+2</td>
<td></td>
</tr>
<tr>
<td>9.0mm</td>
<td>-1</td>
<td>0</td>
<td>+1</td>
<td>+2</td>
<td></td>
</tr>
<tr>
<td>9.5mm</td>
<td>H</td>
<td>-1</td>
<td>0</td>
<td>+1</td>
<td></td>
</tr>
<tr>
<td>10.0mm</td>
<td>H</td>
<td></td>
<td>-1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>10.5mm</td>
<td>H</td>
<td></td>
<td></td>
<td></td>
<td>-1</td>
</tr>
</tbody>
</table>

(Suggested Combinations only-individual patient selection may vary)

H ring must be used with caution-verify OZ with applanator lens. Be aware of the large flap diameters created with the H ring.
"Methicillin-Resistant Ocular Infection"
Donald N Serafano MD

<table>
<thead>
<tr>
<th>The Threat of MRSA</th>
<th>Visual Implications of MRSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 1950 1-2% of all infections were MRSA</td>
<td>• MRSA infections often results in tissue necrosis and sloughing of the epithelium and stroma</td>
</tr>
<tr>
<td>• 2000 50 % of all infections are MRSA</td>
<td>• Fibroblasts, derived from histiocytes and keratocytes, form scar tissue</td>
</tr>
<tr>
<td>• Resistance is to Methicillin and other beta-lactamase antibiotics, with increasing resistance to fluoroquinolones</td>
<td>Review of Ophthalmology, September 2008, pages 82-85</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MRSA following Lasik or PRK</th>
<th>Evolution of Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Visual outcomes of 12 patients: 2 eyes required excision of the necrotic flap and 2 eyes required PKP and 4 eyes are pending PKP (46%)</td>
<td>• MRSA is found in normal flora of 24% of population</td>
</tr>
<tr>
<td>• AJO 2007:143:4:629-34</td>
<td>• MRSA likely developed for the penicillin-resistant strains of S. aureus (1944)</td>
</tr>
<tr>
<td></td>
<td>• MRSA strains are 82-92% resistant to the fluoroquinolones</td>
</tr>
<tr>
<td></td>
<td>• Overuse of antibiotics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fighting MRSA</th>
<th>Treating MRSA Infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Trimethoprim is 93.9% effective</td>
<td>• Culture and sensitivity</td>
</tr>
<tr>
<td>• Cycling between different classes of antibiotics e.g. aminogycosides and fluoroquinolones</td>
<td>• Vancomycin, fourth generation fluoroquinolones, gentamycin, sulfacetamide, and bacitracin</td>
</tr>
<tr>
<td>• New beta-lactam antibiotics – carbapenems (not yet approved)</td>
<td>• Rapid, efficient recognition</td>
</tr>
<tr>
<td>• Rapid, efficient recognition</td>
<td>• Beware of blepharconjunctivitis and dacryocystitis – treat with bacitracin ointment, sulfa drops, Polytrim</td>
</tr>
<tr>
<td>• Beware of blepharconjunctivitis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decentration After Refractive Surgery
Paolo Vinciguerra MD

ABSTRACT

PURPOSE: To examine factors useful in evaluation of suspect decentration after refractive surgery.

METHODS: We evaluated 148 cases (eyes) referred to us for recentering procedures by review of information obtainable by evaluation of pupil position, corneal topography, and corneal curvature gradient.

RESULTS: Only a minority of eyes (n=5, 3.4%) were truly decentered; in the remaining majority a high dioptric gradient with consequent focal scarring was present (n=107, 72.3%). In 28 eyes (18.9%), a drifting of the eye during treatment was responsible, and in eight eyes (5.4%), a central island was observed.

CONCLUSIONS: Proper corneal topographical diagnosis reduces the risk of improperly suspecting decentration, and for most cases, smoothing of the central cornea is a simple and efficacious solution.

Recommendations for the prevention of decentration include proper patient positioning, special care in treating high myopes, preoperative check of pupil displacement nasally, evaluation of preoperative map with detection of high temporal curvature gradient, and use of the cross-cylinder technique in the treatment of astigmatism. [J Refract Surg 2001;17(suppl):Sxxx-Sxxx]

Decentration in laser refractive surgery may be suspected when postoperative vision is poor, and irregular astigmatism as well as corneal topographical abnormalities are present. An important concept in the evaluation of corneal topography after refractive surgery is that of the “red ring.” A red ring can be visualized on the corneal topographical map using the tangential or elevation algorithms, which indicate the change in curvature between the treated and untreated cornea (Fig 1). A centered treatment shows the ablated area in blue with a peripheral red ring, both well centered on the pupil; in true decentration, they appear decentered with respect to the pupil (Figs 2, 3). Pseudo-decentration features a centered red ring, and a decentered ablation area. Together with characteristics of the red ring, evaluation of a suspect decentration must take several factors into consideration: pupil position, corneal topographical map, corneal curvature gradient, ablated area.

Pupil
In evaluating the pupil, care must be taken to remember the prismatic effect induced by decentration, which moves the image of the pupil in the direction opposite to decentration.

Corneal Topography
Two corneal topographical algorithms can be especially useful in the evaluation of decentration: axial and tangential (instant). The axial algorithm shows the refractive result of ablation (ie, the optical zone), and the tangential defines the ablation borders, its centration, and the position of the red ring. Important features of the red ring include its width, centration, distance from the pupillary margin, and dioptric gradient from the center to the periphery of the cornea.
Corneal Curvature Gradient
A high corneal dioptric gradient between the treated and untreated cornea creates a smaller optical zone, and increases the refractive effect of decentration. An uneven distribution of the dioptric gradient leads to pseudo-decentration. When evaluating hyperopic eyes, care must be taken to remember that the ablation area appears red in color, and the red ring becomes a blue ring, expressing relative flatness of the periphery with respect to the corneal center. Preoperative position of the pupil with respect to the corneal vertex must be taken into account, since eyes with a very nasal pupil naturally after ablation will show an asymmetric curvature gradient, more pronounced on the temporal side, with a temporally wider and more intense red ring.

Ablated Area
Pseudo-decentration may be caused by focal scarring, uneven distribution of the corneal dioptric gradient, or high corneal dioptric gradient. The uneven distribution may result from a nasally located pupil, astigmatism correction only on one meridian, and central island. In evaluating a case of suspect decentration, an irregular optical zone with a properly centered red ring probably indicates the occurrence of focal scarring, with erosion of the ablation area and an irregular optical zone (Fig 4). The tangential map is essential in this case.

Astigmatism correction with commonly used techniques leads to an incomplete red ring placed in the meridian of previous greater curvature. The optical zone will appear wider on one meridian. The cross-cylinder technique, on the contrary, allows creation of a prolate cornea, with a homogeneously wide optical zone and no red ring.

Occurrence of a central island will cause irregularity of the optical zone, which will appear decentered. High myopia correction represents an especially difficult situation. In these cases, even a mild decentration, coupled with an intense curvature gradient, may lead to focal scarring with reduction of an already small optical zone.

Tilting of the eye means an ablation zone imparted asymmetrically on the cornea, in the direction opposite to tilting, thus gaining an oval shape.

Careful evaluation of 148 cases referred to us for recentering procedures has highlighted that only a minority of eyes (n=5, 3.4%) were truly decentered. In the majority of eyes, a high dioptric gradient with consequent focal scarring was present (n=107, 72.3%), in 28 eyes (18.9%) a drifting of the eye during treatment was responsible, and in eight eyes (5.4%) a central island was observed.

Proper corneal topographical diagnosis reduces the risk of improperly suspecting decentration, and for most cases (ie, high dioptric gradient, irregular ablation), smoothing of the central cornea is a simple and efficacious solution. Recommendations for the prevention of decentration include proper patient positioning, special care in treating high myopes, preoperative check of pupil displacement nasally, evaluation of preoperative map with detection of high temporal curvature gradient, and use of the cross-cylinder technique in the treatment of astigmatism.
“Prevention Of Corneal Ectasia In Laser In Situ Keratomileusis”
Paolo Vinciguerra MD

ABSTRACT

PURPOSE: Ectasia after laser in situ keratomileusis (LASIK) is a rare but serious complication. Prevention includes proper patient selection with detection of those at particular risk. Causes of ectasia include predisposition, excessive ablation with less than 250 µm of residual stromal bed, thicker than normal flap, irregular corneal thickness, and different ablation rates.

METHODS: We evaluated corneal curvature patterns and their relationship to corneal topography and pachymetry maps.

RESULTS: Corneal topography (axial, tangential, and altimetric) and pachymetry map characteristics of normally astigmatic corneas, keratoconus, false-positive and false-negative cases, as well as contact lens-induced warpage are discussed.

CONCLUSIONS: Preoperative pachymetry maps for LASIK surgery allow accurate case selection through detection of borderline cases, and provide important documentation of preoperative status, as well as useful information for improving surgical strategy. Another important parameter is the asphericity index.

[J Refract Surg 2001;17(suppl):S187-S189]
Corneal ectasia after laser in situ keratomileusis (LASIK) surgery is a rare but serious complication, and prevention includes proper patient selection with detection of those at particular risk. Causes of ectasia include predisposition, excessive ablation with less than 250 µm of residual stromal bed, thicker than normal flap with consequent ablation at a deeper than planned level, irregular corneal thickness, and different ablation rates.

Evaluation of corneal thickness with simple ultrasonic pachymetry unfortunately has the main limit of exploring one or just a few corneal points, and not the entire cornea.

Keratoconus cases are especially at risk for ectasia, and must be identified. Common criteria include higher than normal curvature values, irregular “bowtie” pattern on axial corneal topography, comparison with the fellow eye, familiarity with keratoconus, stability of astigmatism, corneal topographical criteria, and evaluation of altimetric corneal topography. Features of a normal cornea include a mean thickness ranging from 540 to 700 µm, respectively, from center to periphery, with greater thickness nasally and inferiorly, and flatness more pronounced nasally (Fig 1). Presently, the most important advancement in preoperative evaluation is the study of the corneal curvature pattern and its relationship to the pachymetry map. This allows a global corneal evaluation, with easy detection of pachymetric abnormalities, and provides indisputable documentation of the preoperative cornea.

Proper evaluation of a pachymetry map must include corneal thickness at the thinnest point, as well as its correspondence with the steepest corneal point, map pattern, gradient, and relationship between central and peripheral corneal thickness and curvature.

In keratoconus, the pachymetry map highlights the following features: eccentric and asymmetric pattern, and eccentric location of the thinnest point, with a value lower than normal. The altimetric map allows evaluation of the correspondence between the thinnest and steepest points, and the height pattern (island or cookielike) (Fig 2).

A normally astigmatic cornea will show a bow-tie pattern on the axial map, a cookielike pattern on the altimetric map, a symmetric aspect of pachymetry, increasing progressively and regularly from center to periphery, and a central thinnest point equal to or greater than 540 µm.

Keratoconus will usually show a high curvature value (ie, 48.00 diopters [D]), an asymmetrical pachymetry map with the thinnest point often decentered inferiorly and temporally, as well as a thinnest point of less than 540 µm, asymmetrically located and corresponding to an equally asymmetrically located steepest point. The altimetric map will show an incomplete or absent cookielike pattern.

False-positive cases may show a small bow-tie on the axial map, perhaps a high curvature value, altimetric pattern resembling more an island than a cookie, but a symmetric pachymetry map, with the thinnest point centered and within normal thickness values (Fig 3).

Contact lens-induced warpage may require a differential diagnosis because the axial map may show an asymmetrical pattern, the altimetric map an irregular cookie, but the pachymetry map will be regularly and symmetrically concentric, with a normally thick cornea.

When should a risk of ectasia be suspected? When the bow-tie on the axial map is small, the corneal curvature is high (ie, 50.00 D), an island pattern is present on the altimetric map, and the pachymetry map is asymmetrical, with less than 540 µm thickness at the thinnest point. In some cases, the axial and altimetric map patterns may be normal, with corneal curvature within normal
limits, but pachymetry appears asymmetrical with a decentered thinnest point less than 540 µm (Fig 4). In other cases, the axial and altimetric maps may show irregular bow-tie and cookie-like patterns, with asymmetrical pachymetry and the thinnest point of lower-than-normal value.

False-negative cases may feature a homogeneous axial map, normal curvature values, an island altimetric pattern, but asymmetrical pachymetry, with an eccentric thinnest point of lower-than-normal value (Fig 5).

Therefore, the pachymetry map is an essential tool for evaluation of cases at risk for corneal ectasia. Minimum pachymetry less than 500 µm, eccentric in position, but not in correspondence with the point of maximal corneal curvature are risk factors.

Another important parameter gaining attention is the asphericity index (e greater than 1). Preoperative pachymetry maps before LASIK allow accurate case selection through detection of borderline cases, and provide important documentation of preoperative status, as well as useful information for improving surgical strategy.
Figure 5. A case of false-negative. Homogeneous axial map (above left), mean corneal curvature of approximately 44.50 D, island on altimetric map (above right), asymmetrical pachymetry map (below left), with eccentric thinnest point of 484 µm.
<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Address</th>
<th>Phone</th>
<th>Fax</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>MARGUERITE B MCDONALD MD</td>
<td>OCLI FL 3, 360 Merrick Rd Lynbrook, New York, 11563-2500 USA</td>
<td>Ph.: 516-593-7709 Fax: 516-887-8380</td>
<td></td>
<td></td>
<td>e-mail: <a href="mailto:margueritemcdmd@aol.com">margueritemcdmd@aol.com</a></td>
</tr>
<tr>
<td>DANIEL EPSTEIN MD</td>
<td>Univ. Zurich Hosp. Augenklinik Univ/Spital Zurich Frauenklinikstrasse 24 Zurich 8091 Switzerland</td>
<td>Ph.: 41 (31) 311 4822 Fax: 41 (31) 311 5976</td>
<td></td>
<td></td>
<td>e-mail: <a href="mailto:beatrice.frueh@insel.ch">beatrice.frueh@insel.ch</a></td>
</tr>
<tr>
<td>RICHARD L LINDSTROM MD</td>
<td>Minnesota Eye Consultants, PA Ste 200 9801 Dupont Ave S Bloomington MN 55431-3200</td>
<td>Ph.: 952-567-6051 Fax: 952-567-6182</td>
<td></td>
<td></td>
<td>e-mail: <a href="mailto:rlindstrom@mneye.com">rlindstrom@mneye.com</a></td>
</tr>
<tr>
<td>MATTEO PIOVELLA MD</td>
<td>C. M. A. Centro Microchirurgia Ambulatoriale Via Donizetti, 24 - 20052 Monza- Italy</td>
<td>Ph.: +39 039389498 Fax:+39 0392300964</td>
<td></td>
<td></td>
<td>e-mail: <a href="mailto:piovella@piovella.com">piovella@piovella.com</a></td>
</tr>
<tr>
<td>DONALD N SERAFANO MD</td>
<td>ViewPoint Laser Center, 3900 Kilroy Airport Way Ste 190, Long Beach CA 90806-6815</td>
<td>Ph.: 562 290-8440 Fax: 562 989-8429 Los Alamitos Med Ctr PO Box 250 Los Alamitos, CA 90720-0250 Ph.: 526-598-3160 Fax: 562 598-7383</td>
<td></td>
<td></td>
<td>e-mail: <a href="mailto:serafano@gte.net">serafano@gte.net</a></td>
</tr>
<tr>
<td>PAOLO VINCIGUERRA MD</td>
<td>Istituto Clinico Humanitas Rozzano Via Ripamonti 205 20141 Milano – Italy</td>
<td>Ph.: +39 02-5521-1388 Fax: +39 02-5741-0355</td>
<td></td>
<td></td>
<td>e-mail: <a href="mailto:info@vincieye.it">info@vincieye.it</a></td>
</tr>
</tbody>
</table>