Two very broad categories of post-surgical issues
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Photoablation Surgery Issues

Optical Issues

Three basic ways you can have a suboptimal visual outcome
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What is the most common cause of overcorrection?
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Stromal dehydration
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How does stromal dehydration lead to overcorrection?
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What surgical factors are common causes of stromal dehydration?
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If the stroma is dehydrated, it ablates more readily, and thus more tissue is removed per laser burst

What surgical factors are common causes of stromal dehydration?
--Allowing too much time to pass between denuding the epithelium/cutting the flap, and ablating the stroma
--Humidity and/or temperature in the excimer room being outside of the manufacturer’s recommendations
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If a pt is overcorrected, how soon should surgical correction be undertaken?
As many pts experience some degree of spontaneous regression over the first 3-6 months, it is prudent to allow several months to pass before intervening
What are the most common causes of undercorrection?

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What are the most common causes of undercorrection?
--High degrees of pre-op myopia or hyperopia
--Spontaneous regression
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What steps can be taken to reduce or even reverse regression leading to undercorrection?
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What steps can be taken to reduce or even reverse regression leading to undercorrection?
--Use of *MMC* at the time of ablation
--Heavy topical steroid use in the post-op period if regression is noted to be ongoing

*(Abbreviations: MMC, Mitomycin C)*
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If a pt is undercorrected, at what point should surgical correction be undertaken?
Once the refraction has stabilized, which usually takes at least 3 months
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What other complication, if present, should prompt the surgeon to wait even longer?
**Post-op haze**—if present, it portends a higher risk for further regression and/or haze formation. In such cases, the prudent course is to wait at least 6-12 months prior to re-treating.
What factors are associated with the presence of post-op aberrations?

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What factors are associated with the presence of post-op aberrations?
-- High degrees of pre-op myopia, hyperopia, or astigmatism
-- A smaller ablation zone
-- The presence of aberrations pre-op
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Which higher-order aberration is most contributory to pt symptoms?
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--The presence of aberrations pre-op

Which higher-order aberration is most contributory to pt symptoms?
Spherical aberration
Five non-visual problems you may encounter post-op
Photoablative Surgery Issues

Structural Issues

Central islands

Decentered ablations

Steroid-induced IOP elevation

Central toxic keratopathy

Infectious keratitis

*Five non-visual problems you may encounter post-op*
In this context, what is a central island?
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A small (<1 mm) area of elevation (at least 1D’s worth) within the area of flattening after myopic ablation
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In terms of symptoms, how does a central island manifest?
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Are central islands a common phenomenon?
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Is the presence of a central island an indication for an immediate surgical revision?
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Are central islands a common phenomenon?
Not with current excimer technology, no.

Is the presence of a central island an indication for an immediate surgical revision?
Many will regress spontaneously, so no.
What are common causes of a decentered ablation?

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- ?
- ?
What are common causes of a decentered ablation?
--Loss of fixation by the operative eye
--Poor pre-op head positioning by the surgeon
--Failure to ensure the operative eye is oriented perpendicular to the laser
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Will decentration regress spontaneously like a central island?
No, it must be addressed surgically
What is the main risk factor for steroid-induced IOP elevation?
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Use after surgery for a prolonged period of time
**Photoablative Surgery Issues**

**Structural Issues**

- Central islands
- Decentered ablations
- **Steroid-induced IOP elevation**
- Central toxic keratopathy
- Infectious keratitis

**What is the main risk factor for steroid-induced IOP elevation?**
Use after surgery for a prolonged period of time

**Which class of procedure is at increased risk?**
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Use after surgery for a prolonged period of time

Which class of procedure is at increased risk?
Surface ablation procedures
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Why surface procedures?
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Use after surgery for a prolonged period of time

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Why surface procedures?
Because steroids are often used for months afterwards to prevent haze formation
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Why is managing IOP after photoablative surgery especially challenging?
What is the main risk factor for steroid-induced IOP elevation?
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Why is managing IOP after photoablative surgery especially challenging?
Because altered corneal thickness and curvature renders applanation tonometry artifactually low. Fluid under a LASIK flap can do the same.
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Because altered corneal thickness and curvature renders applanation tonometry artifactually low. Fluid under a LASIK flap can do the same. The only method of measuring IOP that is reliable after photoablative refractive surgery is two words: **dynamic contour tonometry.**
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Is it rare, or common?
What is central toxic keratopathy?
The development of acute, nonprogressive central corneal opacification in the immediate post-op period

Is it rare, or common?
Rare
**Photoablative Surgery Issues**

- Central islands
- Decentered ablations
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**What is central toxic keratopathy?**
The development of acute, nonprogressive central corneal opacification in the immediate post-op period

**Is it rare, or common?** Inflammatory, or noninflammatory?
Rare
**What is central toxic keratopathy?**
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*Is it rare, or common? Inflammatory, or noninflammatory?*
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Central islands
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Photoablative Surgery Issues
Structural Issues

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**Photoablative Surgery Issues**

**Structural Issues**

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Photoablative Surgery Issues

Structural Issues

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In addition to haze formation, what other undesirable effect does it have?
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How is it treated?
Hypertonic solutions have been proposed, but their efficacy remains unproven
Which is more vulnerable to post-op infection--surface ablation, or LASIK?
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Why are surface-based procedures at greater risk for infection?
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Surface ablation

Why are surface-based procedures at greater risk for infection?
Because the surgical technique involves creating a huge epi defect, thereby stripping the cornea of one of its primary defenses (ie, an intact epithelium)
Which is more vulnerable to post-op infection—surface ablation, or LASIK?
Surface ablation

Why are surface-based procedures at greater risk for infection?
Because the surgical technique involves creating a huge epi defect, thereby stripping the cornea of one of its primary defenses (ie, an intact epithelium). Further, post-op management of surface surgery involves BCLs as well as long-term steroid use, both of which further the risk of bacterial infection.
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Which bugs are most commonly implicated?
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Are flap-based procedures immune to infection?
*Photoablative Surgery Issues*

**Structural Issues**

- Central islands
- Decentered ablations
- Steroid-induced IOP elevation
- Central toxic keratopathy

**Infectious keratitis**

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Definitely not. Bugs sequestered under the flap are shielded from the antimicrobial content of the tear film.
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Are flap-based procedures immune to infection?
Definitely not. Bugs sequestered under the flap are shielded from the antimicrobial content of the tear film. Treatment requires lifting the flap, scraping it for C&S, and irrigating with abx prior to re-placement.
Infectious keratitis after LASIK
What post-surgical maneuver after surface ablation puts the pt at increased risk for sterile infiltrates?

(Note: There is some degree of overlap between the following questions and those from the previous section)
What post-surgical maneuver after surface ablation puts the pt at increased risk for sterile infiltrates?

- The use of a **BCL**, especially in conjunction with the use of topical NSAIDs without concurrent topical steroids.
What post-surgical maneuver after surface ablation puts the pt at increased risk for sterile infiltrates?

- The use of a BCL, especially in conjunction with the use of topical NSAIDs without concurrent topical steroids
Post-surface ablation sterile infiltrates
Surface Ablation Issues I: Sterile Infiltrates

- What post-surgical maneuver after surface ablation puts the pt at increased risk for sterile infiltrates?
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- What are the keys to management of sterile infiltrates?
  -
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Q/A

Surface Ablation Issues I: Sterile Infiltrates

- **What post-surgical maneuver after surface ablation puts the pt at increased risk for sterile infiltrates?**
  - The use of a **BCL**, especially in conjunction with the use of **topical NSAIDs** without concurrent **topical steroids**

- **What are the keys to management of sterile infiltrates?**
  - Make sure it’s **sterile** (ie, that it’s not **infectious**)
  - Add **topical steroids** and taper **topical NSAIDs**
A Surface Ablation Issues I: Sterile Infiltrates

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Post-surface-ablation haze can be divided into two categories based on time of onset—what are they?

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Post-surface-ablation haze can be divided into two categories based on time of onset—what are they?

- Early onset
- Late onset
Post-surface-ablation haze can be divided into two categories based on time of onset—what are they?

- Early onset.
- Late onset.

For each, how long after surgery until it appears?
Post-surface-ablation haze can be divided into two categories based on time of onset—what are they?

- Early onset. A couple of weeks.
- Late onset. Six to twelve months.

For each, how long after surgery until it appears?
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For each, at what level in the K is the haze located?
Post-surface-ablation haze can be divided into two categories based on time of onset—what are they?

- Late onset. Six to twelve months. Anterior stroma.

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What are the risk factors for development of severe haze?
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- Late onset. Six to twelve months. Anterior stroma.

For each, how long after surgery until it appears?

For each, at what level in the K is the haze located?

What are the risk factors for development of severe haze?

- Deep vs shallow ablation
- Small vs large ablation zone
Post-surface-ablation haze can be divided into two categories based on time of onset—what are they?

- Late onset. Six to twelve months. Anterior stroma.

For each, how long after surgery until it appears?

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- Small ablation zone

How is haze treated?
Q/A

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- Late onset. Six to twelve months. Anterior stroma.

For each, how long after surgery until it appears?

For each, at what level in the K is the haze located?

What are the risk factors for development of severe haze?
- Deep ablation
- Small ablation zone

How is haze treated?
- Increase steroid use. If this fails…
Post-surface-ablation haze can be divided into two categories based on time of onset—what are they?
- Late onset. Six to twelve months. Anterior stroma.

For each, how long after surgery until it appears?

For each, at what level in the K is the haze located?

What are the risk factors for development of severe haze?
- Deep ablation
- Small ablation zone

How is haze treated?
- Increase steroid use. If this fails…
- Debridement in conjunction with topical MMC
**Figure 1.** Slit-lamp microscopy of a cornea before scraping and mitomycin C treatment. The central scar is dense and leads to an irregular and whitish surface.

**Figure 2.** The same cornea as Figure 1 after scraping and mitomycin C treatment. Six months after the procedure the corneal tissue is clear and no trace of haze is evident.

Post-surface ablation corneal haze: Pre- and post tx
LASIK Issues I: Cutting The Flap

- Cutting the flap with a microkeratome...problems
  - Adequate suction induces an IOP of at least # mmHg
LASIK Issues I: Cutting The Flap

- Cutting the flap with a microkeratome...problems
  - Adequate suction induces an IOP of at least 65 mmHg
LASIK Issues I: Cutting The Flap

- Cutting the flap with a microkeratome...problems
  - Adequate suction induces an IOP of at least $65$ mmHg
  - Inadequate suction ↑ the risk of a flap prob 1 or flap prob 2
LASIK Issues I: Cutting The Flap

- **Cutting the flap with a microkeratome...problems**
  - Adequate suction induces an IOP of at least \(65\) mmHg
  - Inadequate suction \(\uparrow\) the risk of a thin flap or buttonhole
Cutting the flap with a microkeratome... problems

- Adequate suction induces an IOP of at least 65 mmHg
- Inadequate suction ↑ the risk of a thin flap or buttonhole
- A steep (>46D) cornea ↑ the risk of a thin flap or buttonhole as well
LASIK Issues I: Cutting The Flap

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  - A flat (<41D) cornea ↑ the risk of a...
LASIK Issues I: Cutting The Flap

- **Cutting the flap with a microkeratome… problems**
  - Adequate suction induces an IOP of at least 65 mmHg
  - Inadequate suction ↑ the risk of a thin flap or buttonhole
  - A steep (>46D) cornea ↑ the risk of a thin flap or buttonhole as well
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LASIK flap: Free cap
Cutting the flap with a microkeratome...problems

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- Inadequate suction ↑ the risk of a thin flap or buttonhole
- A steep (>46D) cornea ↑ the risk of a thin flap or buttonhole as well
- A flat (<41D) cornea ↑ the risk of a free cap

How do you manage a...
- Thin flap/buttonhole?
**LASIK Issues I: Cutting The Flap**

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**How do you manage a...**

- Thin flap/buttonhole? Stop the procedure; re-cut in 3-6 months
- Free cap?
LASIK Issues I: Cutting The Flap

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  - Inadequate suction ↑ the risk of a thin flap or buttonhole
  - A steep (>46D) cornea ↑ the risk of a thin flap or buttonhole as well
  - A flat (<41D) cornea ↑ the risk of a free cap

- **How do you manage a…**
  - Thin flap/buttonhole? Stop the procedure; re-cut in 3-6 months
  - Free cap? Place in antidessication chamber; finish the procedure; re-place the cap +/- sutures
Flap Striae

Two broad category of striae

?  ?
LASIK Issues II: Flap Striae and Dislocation

Flap Striae

Two broad category of striae

Macrostriae

Microstriae
Flap Striae

Two broad categories of striae

- Macrostriae
- Microstriae
LASIK Issues II: Flap Striae and Dislocation

Flap Striae

- Two broad category of striae
  - Macrostriae
  - Microstriae

What are the two main risk factors for striae?
- ?
- ?
Flap Striae

Two broad category of striae

Macrostriae

Microstriae

What are the two main risk factors for striae?

- Thin vs. thick flaps
- Deep vs. shallow ablations
**LASIK Issues II: Flap Striae and Dislocation**

**Flap Striae**

- Two broad categories of striae
  - Macrostriae
  - Microstriae

*What are the two main risk factors for striae?*
- Thin flaps
- Deep ablations
LASIK Issues II: Flap Striae and Dislocation

Flap Striae

Two broad category of striae

Macrostriae

Microstriae

Do all striae require treatment?
Flap Striae

Two broad category of striae

- Macrostriae
- Microstriae

Do all striae require treatment?
No. If BCVA and subjective VA are good, folds can be observed.
LASIK Issues II: Flap Striae and Dislocation

Flap Striae

Two broad category of striae

Macrostriae  Extent of flap involved  Microstriae
LASIK Issues II: Flap Striae and Dislocation

Flap Striae

Two broad category of striae

Macrostriae

Full flap

Extent of flap involved

Microstriae

Bowman’s layer only
**LASIK Issues II: Flap Striae and Dislocation**

**Flap Striae**

- **Two broad category of striae**
  - **Macrostriae**
    - Full flap
    - Extent of flap involved
    - Clinically significant?
  - **Microstriae**
    - Bowman’s layer only
Flap Striae

Two broad
category of striae

Macrostriae
- Full flap
- Always
  - Extent of flap involved
  - Clinically significant?

Microstriae
  - Bowman’s layer only
  - Rarely
LASIK Issues II: Flap Striae and Dislocation

Flap Striae

Two broad category of striae

Macrostriae
- Full flap
- Always
- Extent of flap involved
- Clinically significant?
- Cause

Microstriae
- Bowman’s layer only
- Rarely
LASIK Issues II: Flap Striae and Dislocation

Flap Striae

Two broad category of striae

Macrostromiae
Full flap
Always
Flap slippage

Extent of flap involved
Clinically significant?
Cause

Bowman’s layer only
Rarely
Flap contracture

Microstromiae
Flap Striae

Two broad category of striae

Macrostriae
- Full flap
- Always
- Flap slippage
  - Extent of flap involved
  - Clinically significant?
  - Cause

Microstriae
- Bowman’s layer only
- Rarely
- Flap contracture

What is probably the most common cause of flap slippage leading to macrostriae?
Flap Striae

Two broad category of striae

Macrostriae
- Full flap
- Always
- Flap slippage
- Extent of flap involved
- Clinically significant?

Microstriae
- Bowman’s layer only
- Rarely
- Flap contracture

What is probably the most common cause of flap slippage leading to macrostriae?
Eyelid squeezing by the pt upon removal of the speculum
Flap Striae

Two broad category of striae

Macrostriae
- Full flap
- Always
- Flap slippage

Microstriae
- Bowman’s layer only
- Rarely
- Flap contracture

Extent of flap involved
Clinically significant?
Cause

A pt has multiple macrostriae, all oriented parallel to one another. They stem from the hinge. What is the likely cause?

Frank slippage of the flap. Re-place it immediately!

Because if left in place, folds quickly become permanent

Within roughly 24 hours
LASIK Issues II: Flap Striae and Dislocation

Flap Striae

Two broad category of striae

Macrostriae
- Full flap
- Always
- Flap slippage

Extent of flap involved
Clinically significant?
Cause

Microstriae
- Bowman’s layer only
- Rarely
- Flap contracture

A pt has multiple macrostriae, all oriented parallel to one another. They stem from the hinge. What is the likely cause? Frank slippage of the flap. Re-place it immediately!
LASIK flap: Folds from flap slippage
Flap Striae

Two broad category of striae

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- Full flap
- Always
- Flap slippage

Microstriae
- Bowman’s layer only
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Extent of flap involved
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A pt has multiple macrostriae, all oriented parallel to one another. They stem from the hinge. What is the likely cause? Frank slippage of the flap. Re-place it immediately!

Why must slippage be addressed immediately?
LASIK Issues II: Flap Striae and Dislocation

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## Flap Striae

### Two broad category of striae

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**Flap slippage**

- **Cause**: Flap contracture
- **Extent of flap involved**
- **Clinically significant?**

### A pt has multiple macrostriae, all oriented parallel to one another. They stem from the hinge. What is the likely cause? Frank slippage of the flap. Re-place it immediately!

**Why must slippage be addressed immediately?**
Because if left in place, folds quickly become permanent

**How quickly?**

- Within roughly 24 hours
A pt has multiple macrostriae, all oriented parallel to one another. They stem from the hinge. What is the likely cause? Frank slippage of the flap. Re-place it immediately!

Why must slippage be addressed immediately? Because if left in place, folds quickly become permanent

How quickly? Within roughly 24 hours
**LASIK Issues II: Flap Striae and Dislocation**

### Flap Striae

#### Two broad category of striae

- **Macrostriae**
  - Full flap
  - Always
  - Flap slippage

- **Microstriae**
  - **Extent of flap involved**: Bowman’s layer only
  - **Clinically significant?**
  - **Cause**: Rarely
  - **Gutter status**: Flap contracture

---

**Q**

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LASIK Issues II: Flap Striae and Dislocation

Flap Striae

Two broad category of striae

Macrostriae
- Full flap
- Always
- Flap slippage
- Widened
  - Extent of flap involved
  - Clinically significant?
  - Cause
  - Gutter status

Microstriae
- Bowman’s layer only
- Rarely
- Flap contracture
- Unaffected
LASIK Issues II: Flap Striae and Dislocation

Flap Striae

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Why do macrostriae tend to widen the flap gutter?
LASIK Issues II: Flap Striae and Dislocation

Flap Striae

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- Widened

Microstriae
- Bowman’s layer only
- Rarely
- Flap contracture
- Unaffected

Extent of flap involved
Clinically significant?
Cause
Gutter status

Why do macrostriae tend to widen the flap gutter? Because the folds reduce the surface area the flap can cover
LASIK Issues II: Flap Striae and Dislocation

Flap Striae

Two broad category of striae

Macrostriae
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- Always
- Flap slippage
- Widened

Microstriae
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- Unaffected

Extant of flap involved
Clinically significant?
Cause
Gutter status
Acute treatment
LASIK Issues II: Flap Striae and Dislocation

Flap Striae

Two broad category of striae

Macrostriae

- Full flap
- Always
- Flap slippage
- Widened
- Lift and replace

Microstriae

- Bowman’s layer only
- Rarely
- Flap contracture
- Unaffected
- Observation; lubrication

Extent of flap involved
Clinically significant?
Cause
Gutter status
Acute treatment
LASIK Issues II: Flap Striae and Dislocation

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**LASIK Issues II: Flap Striae and Dislocation**

**Flap Striae**

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*Extent of flap involved*

*Clinically significant?*

*Cause*

*Gutter status*

*Acute treatment*

*Classic description*
Flap Striae

Two broad category of striae

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Full flap
Always
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Lift and replace
‘Skewed carpet’

Extent of flap involved
Clinically significant?
Cause
Gutter status
Acute treatment
Classic description

Microstriae
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Rarely
Flap contracture
Unaffected
Observation; lubrication
‘Cracked mud’

What clinical maneuver helps bring out the cracked mud appearance?
LASIK Issues II: Flap Striae and Dislocation

Flap Striae

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- ‘Cracked mud’

Extent of flap involved
Clinically significant?
Cause
Gutter status
Acute treatment
Classic description

What clinical maneuver helps bring out the cracked mud appearance?
Instillation of fluorescein. The microstriae will be visualized as areas of positive vs negative staining.
LASIK Issues II: Flap Striae and Dislocation

### Flap Striae

- **Macrostriae**
  - Full flap
  - Always
  - Flap slippage
  - Widened
  - Lift and replace
  - ‘Skewed carpet’

- **Microstriae**
  - Bowman’s layer only
  - Rarely
  - Flap contracture
  - Unaffected
  - Observation; lubrication
  - ‘Cracked mud’

**Extent of flap involved**

**Clinically significant?**

**Cause**

**Gutter status**

**Acute treatment**

**Classic description**

---

What clinical maneuver helps bring out the cracked mud appearance? **Instillation of fluorescein.** The microstriae will be visualized as areas of negative staining.
Microstriae: ‘Cracked mud’ appearance after fluorescein instillation
LASIK Issues II: Flap Striae and Dislocation

**Flap Striae**

Two broad category of striae

**Macrostriae**
- Full flap
- Always
- Flap slippage
- Widened
- Lift and replace
- ‘Skewed carpet’

- Extent of flap involved
- Clinically significant?
- Cause
- Gutter status
- Acute treatment
- Classic description
- Visible w/ direct illumination

**Microstriae**
- Bowman’s layer only
- Rarely
- Flap contracture
- Unaffected
- Observation; lubrication
- ‘Cracked mud’
**LASIK Issues II: Flap Striae and Dislocation**

**Flap Striae**

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Visible w/ direct illumination

Extent of flap involved

Clinically significant?

Cause

Gutter status

Acute treatment

Classic description
Flap Striae

Two broad category of striae

Macrostriae

Full flap
Always
Flap slippage
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Lift and replace
‘Skewed carpet’
Yes

Extent of flap involved
Clinically significant?
Cause
Gutter status
Acute treatment
Classic description
Visible w/ direct illumination

Microstriae

Bowman’s layer only
Rarely
Flap contracture
Unaffected
Observation; lubrication
‘Cracked mud’
No

A pt is found to have circumferential striae. What was likely her pre-op refractive status?
A pt is found to have **circumferential** striae. What was likely her pre-op refractive status? High myopia
A pt is found to have circumferential striae. What was likely her pre-op refractive status? High myopia

Are circumferential striae more or less concerning than other types of striae?
# Flap Striae

**Two broad category of striae**

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- **Visible w/ direct illumination**: Yes - No
- **Extent of flap involved**
- **Clinically significant?**

---

A pt is found to have **circumferential** striae. What was likely her pre-op refractive status? High myopia

Are **circumferential striae** more or less concerning than other types of striae? Less. They usually resolve spontaneously.
Flap dislocation

- **Early**
  - Often occurs on post-op day
LASIK Issues II: Flap Striae and Dislocation

- Flap dislocation
  - Early
    - Often occurs on post-op day 1
Flap dislocation

Early

- Often occurs on post-op day 1
  - In immediate post-op period, adhesion between flap epithelium and tarsal conj can be stronger than tensile strength of epithelial bridge across flap gutter.
Flap dislocation

- Early
  - Often occurs on post-op day 1
    - In immediate post-op period, adhesion between flap epithelium and tarsal conj can be stronger than tensile strength of epithelial bridge across flap gutter
LASIK flap: Early post-op dislocation
Flap dislocation

Early

- Often occurs on post-op day 1
  - In immediate post-op period, adhesion between flap epithelium and tarsal conj can be stronger than tensile strength of epithelial bridge across flap gutter

Late

- Usually secondary to two words
Flap dislocation

Early
- Often occurs on post-op day 1
  - In immediate post-op period, adhesion between flap epithelium and tarsal conj can be stronger than tensile strength of epithelial bridge across flap gutter

Late
- Usually secondary to blunt trauma
Flap dislocation

Early
- Often occurs on post-op day 1
  - In immediate post-op period, adhesion between flap epithelium and tarsal conj can be stronger than tensile strength of epithelial bridge across flap gutter

Late
- Usually secondary to blunt trauma
  - Some healing/scarring occurs at the edge of the flap, but essentially none at the rest of the flap/stroma interface
Flap dislocation

**Early**
- Often occurs on post-op day 1
  - In immediate post-op period, adhesion between flap epithelium and tarsal conj can be stronger than tensile strength of epithelial bridge across flap gutter

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- Usually secondary to blunt trauma
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Flap dislocation

**Early**
- Often occurs on post-op day 1
  - In immediate post-op period, adhesion between flap epithelium and **tarsal conj** can be stronger than tensile strength of epithelial bridge across flap gutter

**Late**
- Usually secondary to **blunt trauma**
  - Some healing/scarring occurs at the edge of the flap, but essentially none at the rest of the flap/stroma interface
  - Lack of extensive healing means flap is always vulnerable to dislocation from blunt force
Flap dislocation

**Early**
- Often occurs on post-op day 1
  - In immediate post-op period, adhesion between flap epithelium and tarsal conj can be stronger than tensile strength of epithelial bridge across flap gutter

**Late**
- Usually secondary to blunt trauma
  - Some healing/scarring occurs at the edge of the flap, but essentially none at the rest of the flap/stroma interface
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- Flap dislocation
  - **Early**
    - Often occurs on post-op day 1
      - In immediate post-op period, adhesion between flap epithelium and tarsal conj can be stronger than tensile strength of epithelial bridge across flap gutter
  - **Late**
    - Usually secondary to blunt trauma
      - Some healing/scarring occurs at the edge of the flap, but essentially none at the rest of the flap/stroma interface
      - Lack of extensive healing means flap is always vulnerable to dislocation from blunt force
  - **Treatment:** Re-place flap ASAP!
Flap dislocation

Early

- Often occurs on post-op day 1
  - In immediate post-op period, adhesion between flap epithelium and tarsal conj can be stronger than tensile strength of epithelial bridge across flap gutter

Late

- Usually secondary to blunt trauma
  - Some healing/scarring occurs at the edge of the flap, but essentially none at the rest of the flap/stroma interface
  - Lack of extensive healing means flap is always vulnerable to dislocation from blunt force

Treatment: Re-place flap ASAP!
LASIK flap: Late, traumatic dislocation
LASIK Issues III: DLK

- DLK…
  - …stands for diffuse lamellar keratitis
DLK…
- …stands for *diffuse lamellar keratitis*
DLK…
- …stands for *diffuse lamellar keratitis*
- aka funny nickname for its grainy appearance
LASIK Issues III: DLK

- DLK…
  - …stands for diffuse lamellar keratitis
  - aka Sands of Sahara for its grainy appearance
Q

LASIK Issues III: DLK

• DLK…
  • …stands for **diffuse lamellar keratitis**
  • aka **Sands of Sahara** for its grainy appearance
  • …is a **[infectious vs non-]** inflammation of the [interface]
LASIK Issues III: DLK

- DLK…
  - ...stands for *diffuse lamellar keratitis*
  - aka *Sands of Sahara* for its grainy appearance
  - ...is a *noninfectious* inflammation of the *flap-bed* interface
LASIK Issues III: DLK

- DLK…
  - ...stands for **diffuse lamellar keratitis**
  - aka **Sands of Sahara** for its grainy appearance
  - ...is a **noninfectious** inflammation of the **flap-bed** interface
  - ...is probably 2° to **very general process** of the **important LASIK location**
LASIK Issues III: DLK

- **DLK**
  - ...stands for **diffuse lamellar keratitis**
  - aka **Sands of Sahara** for its grainy appearance
  - ...is a **noninfectious** inflammation of the **flap-bed** interface
  - ...is probably 2° to **contamination** of the **interface**
DLK...

- ...stands for **diffuse lamellar keratitis**
- aka **Sands of Sahara** for its grainy appearance
- ...is a **noninfectious** inflammation of the **flap-bed** interface
- ...is probably 2° to **contamination** of the **interface** (with ...

1...  2...  3 possible culprits...,

etc)
LASIK Issues III: DLK

- DLK…
  - …stands for *diffuse lamellar keratitis*
  - aka *Sands of Sahara* for its grainy appearance
  - …is a *noninfectious* inflammation of the *flap-bed* interface
  - …is probably 2º to *contamination* of the *interface* (with rust, RBCs, bacterial products, etc)
LASIK Issues III: DLK

- DLK...
  - ...stands for *diffuse lamellar keratitis*  
    - aka *Sands of Sahara* for its grainy appearance  
  - ...is a *noninfectious inflammation of the flap-bed interface*  
  - ...is probably 2º to *contamination of the interface* (with *rust, RBCs, bacterial products, etc*)

*In a nutshell:* DLK represents the accumulation of *WBCs* in the potential sub-flap space secondary to *K layer (two words)* inflammation that develops in response to the presence in the interface of a mechanical or toxic insult
DLK…

- ...stands for **diffuse lamellar keratitis**
  
  - aka **Sands of Sahara** for its grainy appearance

- ...is a **noninfectious** inflammation of the flap-bed interface

- ...is probably 2o to **contamination** of the interface (with rust, RBCs, bacterial products, etc)

*In a nutshell:* DLK represents the accumulation of **WBCs** in the potential sub-flap space secondary to **anterior stromal** inflammation that develops in response to the presence in the interface of a mechanical or toxic insult
DLK...

...stands for **diffuse lamellar keratitis**

aka **Sands of Sahara** for its grainy appearance

...is a **noninfectious** inflammation of the **flap-bed** interface

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<td>None</td>
<td>PF q1° + PO prednisone</td>
</tr>
<tr>
<td></td>
<td>centrally</td>
<td></td>
<td></td>
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<td>?</td>
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Because you **really** don’t want DLK to progress to Grade 4…

The *Refractive Surgery* book recommends that ‘the surgeon should have a low threshold for irrigating under the flap in suspected cases of severe DLK’
LASIK Issues III: DLK

Stage 3

Stage 4

More DLK pics
**LASIK Issues III: DLK**

- **DLK vs Infectious Keratitis after LASIK**

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Your LASIK pt looks great—until two weeks or so post-op, when she develops what appears to be DLK. Should you crank up the steroids?

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**Briefly, what is PISK?**
An accumulation in the flap-stroma interface of aqueous transudated across the endothelium by a steroid-induced elevation in IOP

**Is PISK common, or rare?**
Rare

**What is the tx?**
Rapid steroid taper + glaucoma meds as needed to control IOP
Q/A

LASIK Issues III: DLK

- DLK vs Infectious Keratitis after LASIK

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Not until you rule out **pressure-induced stromal keratopathy (PISK)**.

Briefly, what is PISK?

An accumulation in the flap-stroma interface of aqueous transudated across the endothelium by a steroid-induced elevation in IOP.

Is PISK common, or rare?

Rare

What is the tx?

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Your LASIK pt looks great—until two weeks or so post-op, when she develops what appears to be DLK. Should you crank up the steroids? Not until you rule out pressure-induced stromal keratopathy (PISK).
LASIK Issues III: DLK

DLK vs Infectious Keratitis after LASIK

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<tr>
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<td></td>
<td></td>
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<tr>
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<td></td>
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<tr>
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Pressure-induced stromal keratopathy (PISK)

An accumulation in the flap-stroma interface of aqueous transudated across the endothelium by a steroid-induced elevation in IOP

Is PISK common, or rare?

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What is the tx?

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**What is PISK?**
An accumulation in the flap-stroma interface of aqueous transudated across the endothelium by a steroid-induced elevation in IOP
PISK. Note the presence of an optically clear, fluid-filled space between the flap and stromal bed.
## LASIK Issues III: DLK

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This is why PISK doesn’t appear before 10 days at the earliest—it takes that long (or longer) for IOP to rise in response to steroids.

**What is PISK?**

An accumulation in the flap-stroma interface of aqueous transudated across the endothelium by a **steroid-induced** elevation in IOP.

**PISK**

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**Is PISK common, or rare?**
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Not necessarily—it depends on how IOP was measured

It was checked via the gold standard of IOP measurement—Goldmann applanation. Now can I assume it’s late-onset DLK?

Mos def not. The presence of a layer of fluid beneath the flap renders applanation tonometry readings falsely low. When PISK is on the DDx, always check IOP with a Tono-Pen (or other device that doesn’t rely on applanation).

Can PISK result in severe vision loss? What is the mechanism of vision loss?
Indeed it can. Straight up uncontrolled, severe glaucoma.
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When?

An enface layer of fluid between the flap and stroma.

Any other explanations for this?

Is it possible that PISK was present all along?

Rapid steroid taper + glaucoma meds as needed to control IOP

What is the tx?
Q

LASIK Issues III: DLK

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**DLK vs Infectious Keratitis after LASIK**

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**LASIK Issues III: DLK**

### Comparison of DLK vs Infectious Keratitis

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These patients should give you pause before proceeding with ablative keratorefractive surgery:
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- The patient with a POCChx of infection
These patients should give you pause before proceeding with ablative keratorefractive surgery:

- The patient with a POcHx of **HSV keratitis**
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*What is the concern re operating on patients with a history of HSV keratitis?*
• These patients should give you pause before proceeding with ablative keratorefractive surgery:
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What is the concern re operating on patients with a history of HSV keratitis? Re-activation of the virus
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What dreaded post-op complication can occur in RA patients after keratorefractive surgery?
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Wound melt
These patients should give you pause before proceeding with ablative keratorefractive surgery:

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*What dreaded post-op complication can occur in RA patients after keratorefractive surgery?* Wound melt

*What ocular condition co-exists with RA, such that the outcome may be suboptimal even in the absence of a wound melt?*
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- The patient with a POchx of HSV keratitis
- The patient with a POchx of DES
- The patient with PMHx of rheumatoid arthritis
- The patient whose pre-op exam suggests the possibility of forme fruste keratoconus or other disorder
These patients should give you pause before proceeding with ablative keratorefractive surgery:

- The patient with a POcHx of **HSV keratitis**
- The patient with a POcHx of **DES**
- The patient with PMHx of **rheumatoid arthritis**
- The patient whose pre-op exam suggests the possibility of **forme fruste keratoconus** or other **ectatic** disorder
These patients should give you pause before proceeding with ablative keratorefractive surgery:

- The patient with a POcHx of HSV keratitis
- The patient with a POcHx of DES
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Of these four conditions, which one is probably most widely regarded as a contraindication to keratorefractive surgery?
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Keratoconus—forme fruste or otherwise

This assertion is technically incorrect. Keratoconus is certainly a contraindication for RK as well as keratoablative procedures such as LASIK and PRK. However, there is a keratorefractive procedure that is not only not contraindicated in keratoconus, it is used to treat keratoconus. What is it?

Corneal inlay (ie, Intacs) procedure

No question—proceed when ready
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Even this is not universal—there are good and honorable surgeons who will perform keratoablative refractive surgery on forme fruste patients.
In this context, what does ectasia refer to?
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Ectatic disorders include:

- Pellucid marginal degeneration
- Keratoglobus
- Terrien marginal degeneration
- KCN

Photoablative Surgery: Speaking of Ectasia…
In this context, what does ectasia refer to? A noninflammatory, progressive disorder of corneal biomechanics which leads to thinning and warping.

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KCN

Keratoglobus

Pellucid marginal degeneration

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Is post-surgery ectasia more common after LASIK, or surface procedures?
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Is post-surgery ectasia more common after LASIK, or surface procedures? LASIK, by a mile.
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While there are many risk factors, two dwarf the others in importance. What are they?

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While there are many risk factors, two dwarf the others in importance. What are they?

- A too-thin residual stromal bed (RSB)
- A cornea predisposed to ectasia (ie, biomechanically abnormal)
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What is the tx?
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While there are many risk factors, two dwarf the others in importance. What are they?

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What is the tx? RGPs; CXL +/- ICRS; PK.