Two very broad categories of post-surgical issues
Two very broad categories of post-surgical issues
Three basic ways you can have a suboptimal visual outcome
Three basic ways you can have a suboptimal visual outcome

Overcorrection

Undercorrection

Aberrations

Optical Issues

Photoablative Surgery Issues
What is the most common cause of overcorrection?
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Stromal moisture state
What is the most common cause of overcorrection?
Stromal dehydration
What is the most common cause of overcorrection?
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How does stromal dehydration lead to overcorrection?
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If the stroma is dehydrated, it ablates more readily, and thus more tissue is removed per laser burst.
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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?
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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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--Heavy topical steroid use in the post-op period if regression is noted to be ongoing
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If a pt is undercorrected, at what point should surgical correction be undertaken?
**Q/A**

**Photoablaative Surgery Issues**

**Optical Issues**
- Overcorrection
- Undercorrection
- Aberrations

**Structural**

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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 # 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?
--?
--?
--?
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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Which higher-order aberration is most contributory to pt symptoms?
Spherical aberration
Photoablative Surgery Issues

Structural Issues

Five non-visual problems you may encounter post-op
Photoablative Surgery 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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As degraded central vision, which may include decreased acuity and monocular diplopia
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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?
Many will regress spontaneously, so no
What are common causes of a decentered ablation?
--?
--?
--?
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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Is decentration more common with myopic, or hyperopic ablations?
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Hyperopic

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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?
What is the main risk factor for steroid-induced IOP elevation?
Use after surgery for a prolonged period of time
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Which class of procedure is at increased risk?
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Surface ablation procedures
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Why surface procedures?
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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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Is it rare, or common?
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Is it rare, or common? Inflammatory, or noninflammatory?
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What is the cause?
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It is unknown as of this writing
Central toxic keratopathy

**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. Noninflammatory.

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It is unknown as of this writing.

**In addition to haze formation, what other undesirable effect does it have?**
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It causes flattening of the anterior cornea, thereby producing a hyperopic shift
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It causes flattening of the anterior cornea, thereby producing a hyperopic shift.

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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Surface ablation

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

- ?
- ?
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?
Surface Ablation Issues II: Haze

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

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For each, how long after surgery until it appears?

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.

For each, how long after surgery until it appears?

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What are the risk factors for development of severe haze?

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What are the risk factors for development of severe haze?

- Deep vs shallow ablation
- Small vs large ablation zone
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How is haze treated?
Post-surface-ablation haze can be divided into two categories based on time of onset—what are they?
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For each, how long after surgery until it appears?

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- Deep ablation
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How is haze treated?
- Increase steroid use. If this fails…
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How is haze treated?
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- 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
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 ↑ the risk of a thin flap or buttonhole
LASIK flap: Buttonhole
LasIK Issues I: Cutting The Flap

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- A flat (<41D) cornea ↑ the risk of a free cap
LASIK flap: Free cap
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- How do you manage a...
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  - 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
LASIK Issues II: Flap Striae and Dislocation

Flap Striae

Two broad category of striae

?  ?
LASIK Issues II: Flap Striae and Dislocation

Flap Striae

Two broad category of striae

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

Flap Striae

- Macrostriae
- Microstriae

Two broad category of striae
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 category 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?
LASIK Issues II: Flap Striae and Dislocation

Flap Striae

- Macrostriae
- Microstriae

Two broad category of striae

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

Microstriae

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

Flap Striae

Two broad category of striae

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

Microstriae
- Bowman’s layer only
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

Always

Full flap
LASIK Issues II: Flap Striae and Dislocation

Flap Striae

Two broad categories of striae

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

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

Two broad categories of striae

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

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

Extent of flap involved

Clinically significant?

Cause

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

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
  - Cause
  - Extent of flap involved
  - Clinically significant?

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?
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
LASIK Issues II: Flap Striae and Dislocation

Flap Striae

Two broad category of striae

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

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

Flap Striae

Two broad category of striae

Macrostriae
- Full flap
- Always
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- 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!

Why must slippage be addressed immediately?
Because if left in place, folds quickly become permanent
LASIK Issues II: Flap Striae and Dislocation

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!

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

- Extent of flap involved
- Clinically significant?

- **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!

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
- Bowman’s layer only
- Rarely
- Flap contracture

Extent of flap involved
Clinically significant?
Cause
Gutter status
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

Two broad category of striae

Macrostriae
- Full flap
- Always
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Microstriae
- Bowman’s layer only
- Rarely
- Flap contracture
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Why do macrostriae tend to widen the flap gutter?
LASIK Issues II: Flap Striae and Dislocation

Flap Striae

Two broad category of striae

Macrostriae
- Full flap
- Always
- Flap slippage
- Widened

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

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

- Full flap
  - Extent of flap involved
  - Clinically significant?
  - Cause
  - Gutter status
  - Acute treatment

Always

Flap slippage

Widened

Microstriae

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

Gutter status

Acute treatment
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

**Flap Striae**

Two broad category of striae

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

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

**Classic description**
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

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

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

Flap Striae

Two broad category of striae

Macrostriae
- Full flap
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- Bowman’s layer only
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- Unaffected
- Observation; lubrication
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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’
  - Extent of flap involved
  - Clinically significant?
  - Cause
  - Gutter status
  - Acute treatment
  - Classic description

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

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
Flap Striae

Two broad
category of 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
Visible w/ direct illumination

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

Flap Striae

Two broad category of striae

Macrostriae
- Full flap
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Microstriae
- Bowman’s layer only
- Rarely
- Flap contracture
- Unaffected
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- ‘Cracked mud’
- No

Extent of flap involved
Clinically significant?
Cause
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Visible w/ direct illumination
## LASIK Issues II: Flap Striae and Dislocation

### Flap Striae

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Two broad category of striae

- **Macrostriae**
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  - Clinically significant?
  - Cause
  - Gutter status
  - Acute treatment
  - Classic description

- **Microstriae**
  - Visible w/ direct illumination

---

A pt is found to have circumferential striae. What was likely her pre-op refractive status?
### LASIK Issues II: Flap Striae and Dislocation

#### Flap Striae

Two broad category of striae

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- Extent of flap involved
- Clinically significant?
- Cause
- Gutter status
- Acute treatment
- Classic description
- Visible w/ direct illumination
- No

---

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

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

### Flap Striae

Two broad category of striae

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**Extent of flap involved**

**Clinically significant?**

**Cause**

**Gutter status**

**Acute treatment**

**Classic description**

**Visible w/ direct illumination**

---

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?
**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’
  - 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?*

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
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 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
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 location, but essentially none at the rest of the location
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

**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
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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

*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
DLK…
  …stands for *diffuse lamellar keratitis*
**LASIK Issues III: DLK**

- **DLK…**
  - …stands for **diffuse lamellar keratitis**
  - aka **funny nickname** for its grainy appearance
DLK…

…stands for **diffuse lamellar keratitis**

aka **Sands of Sahara** for its grainy appearance
LASIK Issues III: DLK

- DLK...
  - ...stands for **diffuse lamellar keratitis**
  - aka **Sands of Sahara** for its grainy appearance
  - ...is a **non-infectious** 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*
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**
**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** (with **rust**, **RBCs**, **bacterial products**, etc)
LASIK Issues III: DLK

- DLK…
  - …stands for **diffuse lamellar keratitis**
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LASIK Issues III: DLK

- DLK...
  - ...stands for *diffuse lamellar keratitis*
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  - ...is a *noninfectious* inflammation of the *flap-bed* interface
  - ...is probably 2° to *contamination* of the *interface* (with rust, RBCs, bacterial products, etc)

*In a nutshell:* DLK represents the accumulation of *K layer (two words)* in the potential sub-flap space secondary to 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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___

**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
Q

LASIK Issues III: DLK

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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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### LASIK Issues III: DLK

#### DLK vs Infectious Keratitis after LASIK

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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.
## LASIK Issues III: DLK

### DLK vs Infectious Keratitis after LASIK

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What is PISK?
Q/A

**LASIK Issues III: DLK**

- DLK vs Infectious Keratitis after LASIK

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**What is PISK?**

An accumulation in the flap-stroma interface of transudated across the endothelium by a two words elevation in IOP.
**LASIK Issues III: DLK**

- **DLK vs Infectious Keratitis after LASIK**

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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.
DLK vs Infectious Keratitis after LASIK

### DLK

- **Time of onset (post-op):** 10-14 days
- **Location:** Peripheral (initially) Can be anywhere
- **Depth of involvement:** Limited to interface
- **Photosensitivity:** Yes
- **Conj injection:** Yes
- **AC reaction:** Rare

### Infectious Keratitis

- **Time of onset (post-op):** At least 2-3 days
- **Location:** Can be anywhere
- **Depth of involvement:** Extends into flap and/or underlying stroma
- **Photosensitivity:** Yes
- **Conj injection:** Yes
- **AC reaction:** Common

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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

**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 the tx?**

Rapid steroid taper + glaucoma meds as needed to control IOP
DLK vs Infectious Keratitis after LASIK

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DLK vs Infectious Keratitis after LASIK

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  - Extends into flap and/or underlying stroma

- **Photosensitivity:**
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- **Pressure-induced stromal keratopathy:**
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- **AC reaction:**
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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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- **Photosensitivity:** Yes
- **Conj injection:** Yes
- **AC reaction:** Rare

### Infectious Keratitis

- **Time of onset (post-op):** At least 2-3 days
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- **Depth of involvement:** Extends into flap and/or underlying stroma
- **Photosensitivity:** Yes
- **Conj injection:** Yes
- **AC reaction:** Common

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*What is the concern re operating on patients with a history of HSV keratitis?*
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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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These patients should give you pause before proceeding with ablative keratorefractive surgery:

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Generally speaking, to what undesirable post-op state does RA (and other connective-tissue conditions) contribute?
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Photoablative Surgery: Other Issues

Post-LASIK corneal melt in an RA pt
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What ocular condition frequently co-exists with RA, such that the outcome of photoablative surgery may be suboptimal even in the absence of poor healing and/or a wound melt?

Can occur in post-photoablative RA patients?

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That of delayed wound healing

Speaking of delayed corneal wound healing... Certain medications are notorious for inducing this, and thus their use is a relative contraindication to photoablative surgery. What are they?

- ? (used to treat migraines and cluster HAs)
- ? (used to treat acne)
- ? (used to treat ventricular arrhythmias)
- ? (used to treat symptoms of menopause, and/or osteoporosis prevention)
- ? (OTC; used to treat allergic conditions)
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

Generally speaking, to what undesirable post-op state does RA (and other connective-tissue conditions) contribute? That of poor/delayed wound healing.

Speaking of delayed corneal wound healing... Certain medications are notorious for inducing this, and thus their use is a relative contraindication to photoablative surgery. What are they?

- Sumatriptan (used to treat migraines and cluster HAs)
- Isotretinoin (used to treat acne)
- Amiodarone (used to treat ventricular arrhythmias)
- HRT (used to treat symptoms of menopause, and/or osteoporosis prevention)
- Antihistamines (OTC; used to treat allergic conditions)
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- Sumatriptan
- Isotretinoin
- Amiodarone
- HRT
- Antihistamines

Note: It’s unclear how strong a contraindication to surgery these meds should be considered. One highly-placed Academy resource states they "are believed to cause delayed corneal wound healing, and caution should be used in pts who take them."

No question—proceed when ready
These patients should give you pause before proceeding with ablative keratorefractive surgery:

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No question—proceed when ready.
Photoablative Surgery: Other Issues

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No question—proceed when ready
What ocular condition frequently co-exists with RA, such that the outcome of photoablative surgery may be suboptimal even in the absence of poor healing and/or a wound melt?

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In addition to delaying wound healing, isotretinoin contributes to suboptimal photoablative outcomes by exacerbating another condition known to negatively impact them—what condition?
Photoablative Surgery: Other Issues

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Isotretinoin can damage meibomian glands, thereby worsening DES
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- The patient with a POcHx of DES
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- 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**
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Of these four conditions, which one is probably most widely regarded as a contraindication to keratorefractive surgery?
Photoablative Surgery: Other Issues

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Keratoconus—forme fruste or otherwise
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Of these four conditions, which one is probably most widely regarded as a contraindication to keratorefractive surgery?

- 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
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
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Keratoconus—forme fruste or otherwise

No question—proceed when ready
These patients should give you pause before proceeding with ablative keratorefractive surgery:

- The patient with a POC hx of HSV keratitis
- The patient with a POC hx of DES
- The patient with PMH of rheumatoid arthritis
- The patient whose pre-op exam suggests the possibility of forme fruste keratoconus or other ectatic disorder

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Keratoconus—forme fruste or otherwise
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

Of these four conditions, which one is probably most widely regarded as a contraindication to keratorefractive surgery?

Keratoconus—forme fruste or otherwise

For more on corneal inlays, see slide-set RS9

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Of these four conditions, which one is probably most widely regarded as a contraindication to keratorefractive surgery?

Keratoconus—forme fruste or otherwise

BTW, even this is not universal—there are good and honorable surgeons who will perform keratoablative refractive surgery on select forme fruste patients

No question—proceed when ready
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
- The pt who is **general health status**
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
- The pt who is [immunocompromised]
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
- The pt who is immunocompromised

*When you hear ‘immunocompromised,’ two health scenarios should spring to mind—what are they?*
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These patients should give you pause before proceeding with ablative keratorefractive surgery:

- The patient with a POCtx of HSV keratitis
- The patient with a POCtx of DES
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- The patient whose pre-op exam suggests the possibility of forme fruste keratoconus or other ectatic disorder
- The pt who is immunocompromised

When you hear ‘immunocompromised,’ two health scenarios should spring to mind—what are they?
--HIV/AIDS
--Cancer
These patients should give you pause before proceeding with ablative keratorefractive surgery:

- The patient with a POcHx of HSV keratitis
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- The patient with PMHx of rheumatoid arthritis
- The patient whose pre-op exam suggests the possibility of forme fruste keratoconus or other ectatic disorder
- The pt who is **immunocompromised**

*When you hear ‘immunocompromised,’ two health scenarios should spring to mind—what are they?*
--HIV/AIDS
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*Why are immunocompromised pts relatively poor candidates for surgery?*
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
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- The pt who is immunocompromised

When you hear ‘immunocompromised,’ two health scenarios should spring to mind—what are they?
--HIV/AIDS
--Cancer

Why are immunocompromised pts relatively poor candidates for surgery? Because they are at increased risk of post-op infection
These patients should give you pause before proceeding with ablative keratorefractive surgery:
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- 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
- The pt who is **immunocompromised**
- The pt who is **condition** or **related activity**
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
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- The pt who is immunocompromised
- The pt who is pregnant or breastfeeding
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- The patient with a POcHx of HSV keratitis
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- The patient with PMHx of rheumatoid arthritis
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- The pt who is immunocompromised
- The pt who is pregnant or breastfeeding

Why are these contraindications to refractive surgery? (Hint: It has nothing to do with any systemic meds given to relax the pt for surgery.)
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
- The pt who is immunocompromised
- The pt who is pregnant or breastfeeding

Why are these contraindications to refractive surgery? (Hint: It has nothing to do with any systemic meds given to relax the pt for surgery.) Both can affect the hydration and/or refractive state of the cornea.
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
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- The pt who is immunocompromised
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These patients should give you pause before proceeding with ablative keratorefractive surgery:

- The patient with a POCChx of HSV keratitis
- The patient with a POCChx 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
- The pt who is immunocompromised
- The pt who is pregnant or breastfeeding

Why are these contraindications to refractive surgery? (Hint: It has nothing to do with any systemic meds given to relax the pt for surgery.) Both can affect the hydration and/or refractive state of the cornea

How long after pregnancy (or breastfeeding) should one wait before performing keratorefractive surgery?
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
- The pt who is **immunocompromised**
- The pt who is **pregnant or breastfeeding**

Why are these contraindications to refractive surgery? (Hint: It has nothing to do with any systemic meds given to relax the pt for surgery.) Both can affect the hydration and/or refractive state of the cornea.

How long after pregnancy (or breastfeeding) should one wait before performing keratorefractive surgery? Most surgeons wait at least 3 months.
In this context, what does ectasia refer to?
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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- Ectatic disorders include:
  - three words
  - different three words
  - one word
  - abb.
**In this context, what does ectasia refer to?** A noninflammatory, progressive disorder of corneal biomechanics which leads to thinning and warping.

- Ectatic disorders include *pellucid marginal degeneration*, *keratoglobus*, *Terrien marginal degeneration*, and *KCN*.
In this context, what does ectasia refer to? A noninflammatory, progressive disorder of corneal biomechanics which leads to thinning and warping.

- Ectatic disorders include **pellucid marginal degeneration**, **keratoglobus**, **Terrien marginal degeneration**, and **KCN**

Is post-surgery ectasia more common after LASIK, or surface procedures?
In this context, what does ectasia refer to? A noninflammatory, progressive disorder of corneal biomechanics which leads to thinning and warping.

- Ectatic disorders include **pellucid marginal degeneration**, **keratoglobus**, **Terrien marginal degeneration**, and **KCN**

Is post-surgery ectasia more common after LASIK, or surface procedures? **LASIK, by a mile**
In this context, what does ectasia refer to? A noninflammatory, progressive disorder of corneal biomechanics which leads to thinning and warping.

- Ectatic disorders include pellucid marginal degeneration, keratoglobus, Terrien marginal degeneration, KCN.

Is post-surgery ectasia more common after LASIK, or surface procedures? LASIK, by a mile.

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

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)
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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Is post-surgery ectasia more common after LASIK, or surface procedures? LASIK, by a mile.

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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?
- A too-thin residual stromal bed (RSB)
- A cornea predisposed to ectasia (ie, biomechanically abnormal)

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