Clinical comanagement of Lasik post-operative complications

Melissa Johnsen  
*Pacific University*

David Moon  
*Pacific University*

Lisa Lingbaoan Stephan  
*Pacific University*

---

**Recommended Citation**

Johnsen, Melissa; Moon, David; and Stephan, Lisa Lingbaoan, "Clinical comanagement of Lasik post-operative complications" (2003).  
*College of Optometry*. 1439.  
https://commons.pacificu.edu/opt/1439

---

This Thesis is brought to you for free and open access by the Theses, Dissertations and Capstone Projects at CommonKnowledge. It has been accepted for inclusion in College of Optometry by an authorized administrator of CommonKnowledge. For more information, please contact  
CommonKnowledge@pacificu.edu.
Clinical comanagement of Lasik post-operative complications

Abstract
This guide provides the optometrist with a quick reference of LASIK post-operative complications currently reported in ophthalmology literature. Since LASIK is becoming a popular procedure, many more optometrists are comanaging post-operative LASIK patients. The complications of LASIK are unique and not found in primary care clinical guides. The description, prevalence, etiology, symptoms, signs, differential diagnosis, and management are presented for each complication. Additional sections aimed at preventing complications are LASIK contraindications, consultation criteria for screening LASIK candidates, a pre-operative examination, and a post-operative examination. Primary sources and review articles are provided for the optometrist to reference. This guide puts a clinically useful LASIK management guide at the fingertips of optometrists.

Degree Type
Thesis

Rights
Terms of use for work posted in CommonKnowledge.
CLINICAL COMANAGEMENT OF
LASIK POST-OPERATIVE COMPLICATIONS

By

MELISSA JOHNSEN, BS
DAVID MOON, BA
LISA LINGBAOAN STEPHAN, BA

A thesis submitted to the faculty of the
College of Optometry
Pacific University
Forest Grove, Oregon
for the degree of
Doctor of Optometry
May 2003, May 2006

Advisor:

PATRICK CAROLINE, COT, FAAO
Authors:

Melissa Johnsen, BS

David Moon, BA

Lisa Stephan, BA

Advisor:

Patrick Caroline, COT, FAAO
ABOUT THE AUTHORS

Melissa Johnsen, BS
In May 1999, Ms. Johnsen received her B.S. with honors in zoology from North Dakota State University. In May 2003, she will receive her Doctor of Optometry from Pacific University College of Optometry. Following graduation, Ms. Johnsen plans to return to her hometown of Fargo, ND to practice primary care optometry and promote children’s vision in the community.

David Moon, BA
David Moon graduated from the University of Washington in 2001 after earning a B.A. in business administration. He is currently pursuing a Doctor of Optometry degree at Pacific University College of Optometry and plans to graduate in the spring of 2006. After graduation, Mr. Moon intends to practice in Washington in a private practice setting.

Lisa B Lingbaoan Stephan, BA
Lisa Stephan received her degree in Biological Sciences from the California State University of Sacramento in the Spring of 1999. During the third year of her optometry program at Pacific University, Lisa and her husband gave birth to their beautiful son. Lisa will graduate in 2003 with her Doctor of Optometry. The three of them plan to return to Northern California where Lisa will practice primary care optometry.
ABSTRACT

This guide provides the optometrist with a quick reference of LASIK post-operative complications currently reported in ophthalmology literature. Since LASIK is becoming a popular procedure, many more optometrists are comanaging post-operative LASIK patients. The complications of LASIK are unique and not found in primary care clinical guides. The description, prevalence, etiology, symptoms, signs, differential diagnosis, and management are presented for each complication. Additional sections aimed at preventing complications are LASIK contraindications, consultation criteria for screening LASIK candidates, a pre-operative examination, and a post-operative examination. Primary sources and review articles are provided for the optometrist to reference. This guide puts a clinically useful LASIK management guide at the fingertips of optometrists.
ACKNOWLEDGEMENTS

This guide was inspired by a conversation between Melissa Johnsen and Patrick Caroline, C.O.T., F.A.A.O. Johnsen, Moon, and Stephan extend a special thanks to Patrick Caroline and James Hale, O.D. for their mentorship and review of the guide. They would also like to thank Patrick Caroline and Casey Eye Institute, Portland, OR for sharing photos. Johnsen would also like to thank Kevin Melicher, O.D. and Thomas Rene, O.D. for allowing her to help comanage LASIK patients.
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>LASIK Contraindications</td>
<td>2</td>
</tr>
<tr>
<td>LASIK Consultation</td>
<td>3</td>
</tr>
<tr>
<td>LASIK Pre-operative Examination</td>
<td>4</td>
</tr>
<tr>
<td>LASIK Post-operative Examination</td>
<td>5</td>
</tr>
<tr>
<td>LASIK Post-operative Complications</td>
<td>6</td>
</tr>
<tr>
<td>Central island</td>
<td>7</td>
</tr>
<tr>
<td>Diffuse lamellar keratitis</td>
<td>8</td>
</tr>
<tr>
<td>Ectasia</td>
<td>10</td>
</tr>
<tr>
<td>Epithelial ingrowth</td>
<td>12</td>
</tr>
<tr>
<td>Flap displacement and macrostriae</td>
<td>13</td>
</tr>
<tr>
<td>Infectious keratitis</td>
<td>14</td>
</tr>
<tr>
<td>Interface debris</td>
<td>15</td>
</tr>
<tr>
<td>Keratitis sicca</td>
<td>16</td>
</tr>
<tr>
<td>Microstriae</td>
<td>17</td>
</tr>
<tr>
<td>Overcorrection, undercorrection, and regular astigmatism</td>
<td>18</td>
</tr>
<tr>
<td>Punctate epithelial keratopathy</td>
<td>19</td>
</tr>
<tr>
<td>Visual aberrations</td>
<td>20</td>
</tr>
</tbody>
</table>
LASIK Contraindications

Absolute contraindications for surgery include:

A. Keratoconus
B. Herpes Simplex Keratitis
C. Uncontrolled Diabetes Mellitus

Relative contraindications for surgery include:

A. Large pupils
B. High level of ammetropia
C. Cornea too flat (< 41 D), too steep (> 47 D), too thin (< 500 microns)
D. Prism Rx
E. Ocular or systemic disease
   a. Significant cataracts
   b. Severe retinal disease
   c. Uncontrolled glaucoma
   d. Collagen disorders
   e. Blepharitis
   f. Pregnancy, lactation (must wait 3 months after pregnancy or lactation)
   g. Epithelial basement membrane dystrophy
   h. Ocular manifestation of autoimmune disease or one on systemic medications for autoimmune disease
F. Perfectionist personality with unrealistic expectations
G. Significant irregular astigmatism
H. Dry eye
LASIK Consultation

Consultation should include:
A. Thorough ocular and systemic case history
B. Pupil assessment in dim illumination
C. Assessment of stability of topography and refractive error
D. Review of all options for vision correction
E. Explain presbyopia and monovision
   a. patient (any age) understands reading glasses are needed now or in future
   b. patient begins trial of monovision with contact lenses prior to LASIK
E. Review of Risks and Expectations
   a. loss of best corrected vision
   b. reduced night vision
   c. post LASIK dry eye
   d. over- or under-correction and enhancements
   e. improvement of natural vision but may need corrective lenses part time
LASIK Pre-operative Examination

Pre-operative (pre-op) examination should include:

A. Pupil size in dim illumination

B. Visual acuity
   a. Uncorrected visual acuity (UCVA)
   b. Best corrected visual acuity (BCVA)

C. Refraction
   a. Manifest refraction
      i. Discontinue rigid gas permeable contact lens (RGP) wear one month for each decade of wear prior to pre-op
      ii. Discontinue soft contact lens (SCL) wear 1-2 weeks prior to pre-op
      iii. No contact lens wear between pre-op and surgery
   b. Cycloplegic refraction

D. Baseline tonometry

E. Assessment of ocular health
   a. Anterior segment exam
   b. Posterior segment exam

F. Thorough patient education
   a. Review of all options for vision correction
   b. Realistic expectations
      i. Post-LASIK dry eye
      ii. Possible loss of BCVA
      iii. Reduced night vision
      iv. Over- or under-correction and enhancements
   d. Patient (any age) understands reading glasses are needed now or in future
LASIK Post-operative Examination

Post-operative (post-op) examinations should include:

A. Ocular history

B. Visual acuity
   a. UCVA
   b. BCVA

C. Manifest refraction

D. Anterior segment exam

E. Patient education
   a. Normal post-LASIK symptoms
   b. Symptoms of complications

F. Schedule next post-op visit
   a. One day
   b. One week
   c. One month
   d. Three month
   e. Six month
   f. Annual

References:


LASIK Post-Operative Complications

This guide is intended for optometrists who co-manage LASIK. The scope of this book is post-operative LASIK complications. LASIK surgeons may encounter intra-operative complications which involve poor exposure, flap complications, and/or ablation complications. Post-operative complications presented in this guide include:

- central island
- diffuse lamellar keratitis
- ectasia
- epithelial ingrowth
- flap displacement
- infectious keratitis
- interface debris
- keratitis sicca
- microstriae
- overcorrection, undercorrection, and regular astigmatism
- punctate epithelial keratopathy
- visual aberrations.
Central Island

Description: Topographically steep, central areas of the cornea resulting in irregular astigmatism

Prevalence: 0-4.7% (Boyd), 5.7% (Johnson)
*Large zone ablations for high dioptic correction with broad beam excimer laser may result in higher prevalence

Etiology: Forms when the ablation plume or fluid over stromal bed absorbs the laser energy and reduces the potency of the ablation

Symptoms: Glare, ghost images

Signs: Irregular astigmatism; steep, central corneal topography; reduced best corrected visual acuity; monocular diplopia

Differential Diagnosis: Ectasia, irregular epithelial healing, increased corneal prolateness

Management: Follow 3-6 months; repeat topography and slit lamp exam to diagnose and rule out ectasia. Central islands will improve over time, yet ectasia tends to worsen. Within six months 25% of central islands resolve spontaneously (Johnson). RGP can improve visual acuity; though RGP wear must discontinue one month before retreatment. Topographically guided scanning spot lasers may improve irregular astigmatism.

References:


Diffuse Lamellar Keratitis

Description: Infiltrates confined to flap interface taking on an appearance of shifting waves of sand

Prevalence: 1.8-4% (Boyd)

*Occurs 1-6 days following surgery, peaks 2-5 days after surgery

Etiology: Multifactorial; debris trapped within flap, bacterial lipopolysaccharide traces left on microkeratome blade following autoclave sterilization, and/or corneal abrasion with subsequent release of interleukin-1 which cause an inflammatory response

Symptoms: Pain, photophobia, foreign body sensation, tearing, reduced visual acuity asymptomatic

Signs: Inflammation confined to interface of flap; absence of anterior chamber reaction, epithelial defect overlying inflammation, and conjunctival injection

Grading Scale

1 White cells in periphery *found day one post-op
2 White cells within the visual axis *found day two post-op
3 Clumps of cells within the visual axis, haze, reduced visual acuity
4 Central stromal necrosis; melt which leads to topographical flattening inducing hyperopia and irregular astigmatism

Differential Diagnosis: Infectious keratitis, epithelial cells, interface opacities

*Infectious keratitis will have a keratitis extending beyond the flap interface into stroma and overlying flap, an anterior chamber reaction, and conjunctival injection.

Management: Begin treatment with fortified antibiotics until bacteria or fungus infection is ruled out by culturing. Treat DLK by instilling Pred Forte 1% OU every hour. Some prefer oral prednisone 60 mg per day. Taper steroid as inflammation decreases. For severe cases, grade 3-4, refer to surgeon for flap to be lifted and irrigated due to risk of corneal melt. Once resolved, RGP lenses can improve acuity for induced irregular astigmatism.

References:


Ectasia

**Description:**
- Anterior ectasia: Progressive steepening of cornea
- Posterior ectasia: Forward movement of the posterior corneal surface with progressive central thinning

**Incidence:** Rare

**Etiology:** Flap formation interrupts the integrity of collagen fibers of the cornea. This change in mechanical strength can cause the cornea to bulge and thin from intraocular pressure.

**Symptoms:** Distortion, blur, fluctuating vision, monocular diplopia

**Signs:** Loss of BCVA, progressive steepening on corneal topography maps, corneal thinning found with slit scanning corneal topography/pachymetry system Orbscan

*Posterior ectasia shows little or no improvement in acuity with RGP.*

**Differential Diagnosis:** Central islands, undercorrection

**Management:** Treat as keratoconus. Enhancements are contraindicated. If mild or moderate, RGP s may improve acuity. If severe, a penetrating keratoplasty may be required.

**References:**


Epithelial Ingrowth

Description: Epithelial cells within the flap interface

Prevalence: 14.7% (Wilson), 4.3% (Farah), 2.2% (Pallikaris), 1% (Gimbel), 1.5% (Stulting) *Occurs most commonly following enhancement surgery and flap complications.

Etiology: Epithelial cells may be introduced into the flap interface: during formation of the flap by the microkeratome, lifting of the flap for enhancements, poor flap adhesion due to stromal edema, epithelial abrasions, flap misalignment, button hole flaps, or ablation strikes on flap edge in hyperopic procedures.

Symptoms: Distortion, blurry vision, irritation, foreign body sensation, pain

Signs: Cysts or pearls of epithelium at flap edge, peninsula or whorl of epithelium at flap edge extending into flap interface, irregular astigmatism found on corneal topography, decreased BCVA.
If severe, dense haze on flap side of interface or flap melt.

Differential Diagnosis: Diffuse lamellar keratitis

Management: Document location and measure extent of ingrowth from flap edge in millimeters. If progressive, refer for lifting of flap and debridement of epithelial ingrowth. If severe or recurrent, flap may need to be sutured to prevent epithelial cells from migrating into the flap interface.

Resources:


Flap Displacement and Macrostriae

**Description:** Flap has moved so that the edges of the epithelium are not aligned 360 degrees, often presents with wrinkles.

**Prevalence:** 1.2% (Gimbel), 0.85% (Stulting)

**Etiology:** Flap slippage is most common within the first 24 hours postoperatively. A wrinkle with flap displacement can be introduced during surgery by a surgical sponge or within the hours immediately following the surgery by improper insertion of a bandage contact lens, removal of the lid speculum, patient rubbing, pressure on the eye while sleeping without the protective shield, or touching the tip of drop applicator to cornea. Lid interaction with a dry cornea can also wrinkle the flap. Rarely does the flap dislodge after one year, but trauma during air bag deployment, being poked in the eye, or other shearing forces from the side may dislodge the flap.

**Symptoms:** Acute onset of pain, foreign body sensation, decreased vision

**Signs:** Flap edge is not aligned with juncture between epithelium and stroma of stromal bed; wrinkles tend to be parallel to flap edge displaced, best viewed with fluorescein pooling or retroillumination; may present with or without striae.

**Differential Diagnosis:** Microstriae

**Management:** If flap is dislocated, refer to surgeon for flap lift and repositioning. The surgeon may utilize sutures or a bandage contact lens to prevent flap slippage.

**References:**


Infectious Keratitis

Description: Ciliary and conjunctival hyperemia with discharge, pain, and whitish stromal infiltrates

Prevalence: 0.02% (Garg)

Etiology: Blepharitis; length of time patient discontinued contact lens wear pre-operatively not sufficient; improper sterilization; non-sterile surgical procedures, non-compliance with antibiotic prophylaxis; High risk patients: epithelial defects, flap displacement, complicated procedures

Symptoms: Decreased visual acuity, pain, photophobia, redness, discharge, foreign body sensation, tearing, eyelid edema

Signs: Most common: ciliary/conjunctival hyperemia, whitish stromal infiltrates which may extend beyond flap interface
Severe: anterior chamber reaction, hypopyon, stromal/flap edema, flap melt, corneal ulcer

Differential Diagnosis: Interface disorders, noninfectious interface debris, diffuse lamellar keratitis, non-tuberculosis mycobacteria should be considered as an etiologic agent in these cases

Management: Treat aggressively with a broadband spectrum antibiotic. Document size, shape and depth of stromal infiltrate or ulcer. Note any AC reaction. Without the use of anesthesia, culture from conjunctiva including the entire lower cul de sac with calcium alginate swabs. Diagnose based on symptoms, slit lamp exam, and lab results. Refer to ophthalmologist for lift of corneal flap and swab with anesthetic. If corneal ulcer present, refer to surgeon for culture. Treat corneal ulcer with a broad antibiotic (as with infectious keratitis). Prescribe cycloplegic depending on severity of ulcer and anterior chamber reaction. Admission to a hospital may be necessary if a sight-threatening infection does exist.

References:


Interface Debris

Description: Trace opacities within flap interface

Prevalence: 6.8% (Farah), 2.2% (Pallikaris)

Etiology: Since the stroma is exposed during surgery, the tear film, unclean irrigating solutions, surgical instruments including sponges and blades, atmospheric pollution in the operating room, or glove powder/talc can deposit materials within the flap interface despite intra-operative irrigation.

Symptoms: Asymptomatic

Signs: Scattered white or metallic specks at the flap interface seen with parallelepiped or optic section

Differential Diagnosis: Diffuse lamellar keratitis, epithelial cells

Management: Monitor for inflammation due to debris at routine intervals.

References:


Keratitis Sicca

Description: Dry eye, insufficient tears

Prevalence: Common; patients with superior hinges have slightly worse symptoms than those with nasal hinges

Etiology: Evidence found from the neurotrophic theory: microkeratome severs the sensory nerve fibers involved in lacrimation, spontaneous firing of the sensory fibers and poorer quality of lipid layer may contribute to dry eye symptoms after LASIK. Studies have shown a reduction of corneal sensation and reflex tear secretion in patients in at least the first 3 months post-LASIK but by 6 months these values have returned to pre-operative levels.

Symptoms: Irritating dryness, pain, asymptomatic due to decreased corneal sensitivity

Signs: Positive phenol red thread test, positive Schirmer test, tear break up time (TBUT) <10 seconds but >1 second, inferior fornix tear meniscus < 0.5 mm, superficial punctate keratopathy, rose bengal staining confined to the flap, corneal filaments if severe, decreased visual acuity if central epitheliopathy

Differential Diagnosis: Epithelial basement membrane dystrophy

Management: Screen and treat any underlying ocular surface disease before surgery.
- Lubricate with non-preserved artificial tears, gels, or ointment tear supplements.
- Educate patient to not rub the eyes.
- Contact lenses should not be used in eyes with low tear levels due the increased risk of microbial infection.
- Consider PRK as an alternative to LASIK for patients with low myopia and mild or moderate dry eye prior to surgery.

References:
Karpecki P. Dry Eye in LASIK: Clues to the Cause. ARVO Abstract: 2001
Microstriae

Description: Fine flap wrinkles

Prevalence: 5.9% (Farah), 0.2% (Pallikaris), 1.1% (Gimbel), 0.13% (Stulting)

*General flap striae rates

Etiology: Often are associated with thin flaps, higher refractive corrections, and grossly overhydrated flaps.

Symptoms: Multiple images, glare, distorted vision

Signs: With direct or indirect retroillumination, flap shows fine gray lines perpendicular to flap hinge without flap displacement.

Differential Diagnosis: Flap displacement with macrostriae, Bowmans’s crinkles

Management: If striae are outside the visual axis, no treatment is necessary. If central vision is affected, refer to surgeon for lifting and repositioning of flap. Flap striae need to be removed within the first month post-operatively for best results. If striae cannot be removed by surgical technique, an RGP fit can improve acuity.

References:


Overcorrection, Undercorrection, and Regular Astigmatism

Description: Refractive error greater than or equal to 0.75 from target with subjective complaint three to six months postoperatively

Prevalence: 5-15% (Boyd)
*Varies directly with magnitude of preoperative refractive error.

Etiology: Inaccurate refraction, improper surgical ablation, decentration, beam non-homogeneity, abnormal corneal hydration status during ablation, excessive or inadequate healing response, LASIK nomogram errors, improper entering of patient’s Rx into laser, epithelial hyperplasia, stromal remodeling, or aborted LASIK procedure

Symptoms: Blur, glare, halos

Signs: Improved acuity with lenses

Differential Diagnosis: Central islands, ectasia
*Refractive errors are normally found in the first month. Often the patient is slightly overcorrected due to the laser nomogram for regression effect. Also there may be some transient induced astigmatism due to corneal healing or tear film disruption.

Management: Dispense temporary spectacles. Disposable contact lenses are safe 1-2 weeks postoperatively. Enhancement LASIK procedure indicated when refraction is stable, usually 3-6 months postoperatively.

References:


Punctate Epithelial Keratopathy

Description: Punctate excavation of epithelium

Prevalence: No rates reported

Etiology: Temporary interruption of the corneal nerves during flap formation. Tear film is more stable six to eight months post-operatively when the nerves have regenerated into the flap.

Symptoms: Asymptomatic, poor BCVA, fluctuating vision, foreign body sensation

Signs: Punctate staining of epithelium with fluorescein

Differential Diagnosis: Epithelial defect, recurrent corneal erosion, keratitis sicca, medicamentosa

Management: Frequent lubrication of ocular surface with nonpreserved artificial tears, and ointment at bedtime. Consider punctal plugs or bandage soft contact lens. Manage any blepharitis or meibomianitis for optimum tears.

References:

Visual Aberration

**Description:** Develops during dim light situations when pupils are dilated larger than laser ablated optic zone

**Prevalence:** Rates not reported  
*Rate varies directly with pupil size, magnitude of pre-operative ametropia, and level of astigmatism*

**Etiology:** Alteration in the distribution of coma and spherical aberration magnitude following pupil dilation, residual refractive error, change in optimal quality of cornea, aspheric cornea becoming oblate, or irregular astigmatism

**Symptoms:** Poor vision in dim lighting, glare, halos, monocular diplopia

**Signs:** Monocular diplopia - wrinkle flap, decentered ablation, central islands; Irregular astigmatism - central islands and peninsula, decentered ablation, ectasia; decreased contrast sensitivity

**Differential Diagnosis:** Central islands, ectasia, irregular astigmatism, irregular ablations, decentered ablations, uncorrected spherocylinder refractive error, pupil enlargement beyond functional optic zone, decrease in media clarity, night myopia

**Management:** Symptoms typically subside over 3 – 6 months (12 months for higher levels of correction), though may be permanent. Best to prevent with larger ablation zones, aspheric ablation profile, or multizone technology. Determine the cause of symptoms and assess degree of functional disability. Refer for enhancement if symptoms resolve with trial spectacles. If no residual refractive error, do topography. If irregular astigmatism, consider RGP. If large pupils, consider miotics. If poor night vision, consider lightly tinted polarized glasses for night driving. Other options include: over minus spectacles or temporary Rx as needed, drive with dome light on, enlarge/blend optic zone, or fit patient with a soft contact lens with artificial pupil.

**References:**
