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INTRODUCTION

Dr. Tyrie Jenkins is a pioneer in refractive surgery, being the first to perform LASIK in Hawaii in 1997. She has also been a very strong advocate of co-management with the optometric community. In 1984, she was one of the first three ophthalmologists to direct Omni Eye Services, a referral clinic founded on the principal of the working relationship with primary care eye doctors. This co-management model of doctors working with secondary and tertiary care ophthalmologists has been successful in Hawaii. This joint arrangement provides patients with the alternative of having their post-operative care provided by their own eye care professional with whom they have a long-standing relationship, in addition to being more accessible, particularly on the neighbor islands. Ongoing and clear communication is essential for ethical and safe co-management in refractive surgery.

This manual is intended to serve as a guide for co-management of LASIK and PRK patients. It includes a brief description of the current surgical technique, pre-operative evaluation and post-operative findings.

Fortunately, most refractive surgery patients experience safe and rapid visual enhancement. However, there are complications that can arise. The ability to recognize these complications and initiating early treatment is paramount to ensure a good visual outcome.

THE HISTORY OF REFRACTIVE SURGERY

Refractive surgery has come a long way. The idea of surgically altering the cornea to correct refractive error was initially conceived in the 1970s by a Russian ophthalmologist, S.N. Fyodorov. He conceived the idea of changing the curvature of the cornea through corneal incisions. This procedure was known as radial keratotomy (RK) and this technique spread to the United States, where it was modified by various American scientists. Another technique developed in the late 1980s in Columbia (and later used in the US in the early 1990s) was automated lamellar keratoplasty (ALK). This technique corrected both high levels of myopia

and hyperopia and involved creating a flap from the outer layer of the cornea. This flap-creating technology would be later used with the advent of laser in-situ keratomileusis (LASIK).

The use of the excimer laser to reshape the cornea to correct refractive error was conceived in 1981. The first use in humans took place in 1985 in Germany and in 1987 in the United States. This procedure was known as photorefractive keratectomy (PRK) and involved ablation of the surface of the cornea, initially to flatten the cornea to correct nearsightedness. Using a laser manufactured by Summit Technology, US clinical trials for FDA approval of PRK began in 1991, with final approval in 1996.

The idea of combining previously proven flap technology and reshaping the cornea with the excimer laser occurred in the early 1990s and the dawn of LASIK surgery began. LASIK surgery was initially performed throughout the 1990s in the US as an “off-label” use of the excimer laser. The initial clinical trials for LASIK began in 1996. Dr. Jenkins contributed clinical data to the studies that helped LASIK gain FDA approval in 1999.

Since the inception of laser refractive surgeries, tens of millions of procedures have been performed throughout the world. It is the most commonly performed elective procedure. There have been multiple advancements in both the flap-making technology and the laser technology. Initially flaps were created with a mechanical keratome, which was essentially a precision oscillating blade. Flaps are now created with a femtosecond laser. The shape, thickness and edge profile can be customized for each patient, minimizing complications related to flap creation. Excimer laser technology has advanced as well, with currently two platforms – broad beam and flying spot. Treatment patterns are now shaped and customized with wavefront technology, a system used to precisely measure the optical aberrations of the eye. Eye tracking has added to the precision of treatments, lowering the incidence for retreatments. Finally, the use of the anti-metabolite mitomycin has helped decrease the incidence of corneal haze formation which has allowed the ability to perform PRK on higher amounts of myopia, increasing the number of patients who are eligible for laser vision correction.

LASER TECHNOLOGY

FLAP-CREATING TECHNOLOGY: In the early days of LASIK, a mechanical keratome was used to create the corneal flap. This was a safe and effective procedure for thousands of patients. Now the procedure can be performed 100% “bladeless” with the use of femtosecond laser technology. The femtosecond laser is an infrared laser that emits an ultrashort laser pulse with the diameter of .001mm at one-billionth of a second. The laser pulse creates energy at a precisely designated depth inside the cornea. Each laser pulse creates a mini gas bubble that separates the corneal tissue (photodisruption). Three-dimensional, high-precision laser cuts are created within the cornea by thousands of computer-positioned laser pulses. Then the corneal flap is lifted up with a precision instrument. The WaveLight FS200 is the fastest femtosecond laser available in Hawaii. The flap is created in 6 seconds or less, and can be customized for each patient. With the FS200, the shape, thickness, size and even the edge bevel can be preset to ensure a more accurate treatment and faster recovery.

CORNEAL RESHAPING TECHNOLOGY: The laser used to reshape the eye is known as the excimer laser. It is an argon-fluoride laser originally designed to etch microchips. It is a cool laser that acts to reshape the cornea by breaking carbon-to-carbon molecular bonds (photoablation as opposed to photodisruption). The laser is in the ultraviolet range (the opposite end of the spectrum than the femtosecond laser) and is therefore invisible to the human eye.

The WaveLight® EX500 excimer laser is the fastest laser system available in the United States. The 500Hz laser is capable of treating one diopter of correction in 1.4 seconds. Reducing the treatment time allows for higher treatments to be completed in a shorter time frame. The pupil-tracking system checks the position of the pupil 250 times per second, precisely adjusting for any eye movement during the procedure. This helps to ensure that the desired refractive correction is achieved with the greatest possible precision.

Wavefront technology has allowed us to better understand the eye’s normal and abnormal optical aberrations. The WaveLight Refractive Suite is designed to integrate the knowledge of wavefront principles into its treatment algorithm. The EX500 system uses this wavefront-

customized system to reshape the patients' cornea to restore more natural vision. The system also has the capacity to perform waverfront-guided treatment from a wavefront mapping system, but it turns out that this is rarely needed for excellent surgical results. The combination of these two laser technologies provides a fast, accurate treatment with rapid recovery of vision.

PATIENT SELECTION

A thorough screening and dilated exam is required to determine if a patient is a good candidate for corneal refractive surgery. The patient should be 21 years or older with healthy eyes, a stable refraction and in good health. When evaluating your patient, please consider the following guidelines:

Absolute contraindications (including but not restricted to):

- Uncontrolled vascular or autoimmune disease
- Pregnant or nursing women (wait until at least 2 normal menstrual cycles after discontinuing breast feeding)
- Patient on Cordarone (amiodarone hydrochloride)
- Uncontrolled collagen vascular disease (lupus, rheumatoid arthritis, Sjogren's disease, scleroderma, etc)
- Keratoconus or other ectatic corneal conditions, e.g. pellucid marginal degeneration
- History of ocular herpes simplex, especially with corneal scarring – refractive surgery may cause reactivation
- Severe dry eyes (keratitis sicca)
- Irregular astigmatism that cannot be improved to 20/20 before surgery
- Ocular surface disease

Relative contraindications (including but not restricted to):

- Controlled or inactive lupus, rheumatoid arthritis (should get clearance from rheumatologist)
- Controlled diabetes
- Monocular status (only one good eye)
- Patients on Accutane (isotretinoin) must have discontinued medication for 6 months with no signs of dry eyes
- Dry eyes with SCL use or post oculoplasty. Dry eye symptoms and signs must be resolved with appropriate dry eye treatment.
- Severe blepharitis and meibomitis must be treated and resolved prior to surgery.

- Recurrent corneal erosion (may benefit more from PRK versus LASIK)

Stable Refraction:

Patient should have a stable prescription for the past year with less than 0.50 diopter spherical equivalent of change. LASIK is approved for treatment up to 11.00D of myopia, 3.75D of astigmatism and 6.00D of hyperopia. For those patients near the maximum (or over) the levels of approved correction, we recommend prior consultation - depending on the age of the patient, corneal thickness and health, there are other treatment modalities that may be a better option, such as Visian ICL or refractive lens exchange.

Pachymetry

Corneal thickness measurement is recommended at the screening, especially for those with higher amounts of myopia. Previous contact lens wear can cause a change in corneal thickness. If you do not have access to a pachymeter, please let us know and we can perform that test for you. The results of this measurement will impact if the patient is a candidate for LASIK, PRK or no surgery at all.

Post-LASIK, it is recommended that the residual stromal bed be above 300 microns, and overall corneal thickness after treatment at least 400 microns in order to reduce risk of corneal ectasia.

Calculating residual stromal bed thickness:

$$\begin{aligned} & \text{Total corneal thickness -} \\ & \text{Flap thickness (100 microns)-} \\ & \underline{\text{Treatment thickness (use 16 microns/diopter) =}} \\ & \text{Residual stromal bed thickness (should be >300 microns)} \end{aligned}$$

Ocular Motility

Please assess the patient carefully for eye muscle imbalance. Patients who have prism in their current glasses should be advised that although their prescription can be reduced with corneal laser procedure, the need for prism in glasses will remain in order to correct their diplopia or asthenopia. Be aware of patients who may not have prism currently in their glasses but experiences eye muscle imbalances with CL wear.

Pupil Size

Pupil size in dim lighting conditions needs to be measured with the patient fixating at a distance object. If the patient is documented to have very large pupils, a discussion about possible risk of glare and halos needs to occur, though as we gain more experience with laser refractive surgery, we now know that pupil size has less of an effect on night glare and halos – it can usually be attributed to residual refractive error and/or dry eye. With larger blended optical zones and higher quality of treatment, glare and halos have been greatly reduced.

Slit Lamp Examination

Examine the lids for any abnormality that can compromise post-operative healing, e.g. lagophthalmos. Diagnose and treat blepharitis, meibomitis and dry eye disease prior to surgery. If there are signs of progressive lens changes, the patient may be served better to have cataract surgery. If there are signs of Epithelial Basement Membrane Dystrophy (aka Map Dot Dystrophy), the patient may be a better candidate for PRK. The presence of corneal neovascularization may lead to bleeding during the flap incision which may cause more inflammation, but is not a contraindication for corneal refractive surgery. Significant corneal scarring would preclude a patient from having LASIK, but PRK may be an option. This is also true for patients with a previous history of RK.

Keratometry

Calculate the likely post-op K-readings – it is recommended that it fall between 36D and 48D. Resultant K-readings above and below these limits are more likely to cause decreased optical quality. To calculate post-op Ks, take the average of the flat and steep pre-operative Ks. For myopic treatments, there is a ~0.8D of flattening per diopter of treatment. For hyperopic treatments, there is a ~1D steepening per diopter of treatment (e.g. a patient with 41D K and a -10D treatment would end up with a very flat 33D K).

Vocation and Avocation

Inquire about your patient's job(s) and hobbies, and their visual needs. Those with high visual demands in low light settings with larger pupils need to be aware of the risk of persistent glare and halos. For presbyopic patients, discuss the need for reading glasses if they are having

distance treatment in both eyes. If they want to be able to see at both distance and near, monovision demonstration with a trial SCL is advised to confirm this decision. If they are involved with contact sports, discuss the potential risk of flap dislodgement if LASIK is chosen versus PRK.

Topography (if available in your office)

The topographer provides information that can assist in deciding if a contact lens wearer has a distorted cornea due to warpage and needs to wait longer before proceeding with corneal surgery. It can also assist in identifying other corneal diseases, e.g. keratoconus, forme fruste keratoconus, pellucid marginal degeneration, etc.

Contact Lens Wearers

For patients wearing contact lenses, they should be aware that they will need to discontinue contact lens wear prior to the cycloplegic/dilated exam and surgery date. The amount of time to be without contact lenses is recommended below:

- Soft lenses: Daily wear: 1 week
- Daily silicone hydrogel: 2 weeks
- Daily Toric: 2 weeks
- Extended wear: 2 weeks

- GP lenses: 3-4 weeks/decade of wear
 (patient can be refit with SCL first and then glasses)

Monovision

For patients experiencing presbyopia, monovision can provide a compromise with one eye (likely non-dominant) treated for near, and the dominant eye for distance. Patients need to understand that this is not a perfect solution; there may be times they may feel they still need glasses or contacts. Advise the patient there is a slight loss of binocularity that may affect their stereo perception. Monovision is not for everyone, thus we encourage patients interested in monovision to go through a SCL trial to demonstrate the proposed treatment.

Patient Expectations

Understanding your patient's post-operative expectations and wishes is paramount to a good outcome. Knowing what motivates your patient to seek surgery and recommending the best option is best determined by the primary eye care provider who has worked with the patient for years. Like any surgery there are limitations, so setting realistic expectations and educating the patient on what to anticipate post-operatively are key to a happy patient.

PRE-OPERATIVE EXAMINATION WITH PRIMARY CARE EYE DOCTORS

LASIK/PRK

If you have a patient interested in corneal refractive surgery, perform a dilated pre-evaluation exam to verify they are a good candidate. This includes, but not limited to the following tests:

1. Medical history - review to rule out non-candidates (e.g. uncontrolled autoimmune disease, diabetes, keratoconus, pregnant or breastfeeding women, etc.)
2. Visual acuities - both uncorrected and corrected
3. Refractive prescription history, looking for stability (0.50D or less change over the past year)
4. Pupil size in dim lighting
5. Ocular motility assessment
6. Pachymetry measurement (if available)
7. Corneal topography (if available)
8. Ocular dominance (e.g sighting eye when using camera)
9. Keratometry readings
10. Dry manifest refraction
11. Cycloplegic refraction with 2gtt of 1% cyclopentolate
12. Dilated fundus exam with peripheral retinal examination
13. Review/treat dry eye problems
14. Review risks and benefits of the procedure
15. Discuss the need to discontinue contact lenses prior to cyclo examination and surgery date: minimum 1 week for daily wear spherical soft contact lenses (SCL), 2 weeks for toric, extended, and silicone hydrogel SCL, and at least 3-4 weeks/decade of wear for gas permeable (GP) patients (GP patients can be given the option to wear SCLS, then wear glasses 1 week prior to surgery).
16. If you are recommending monovision for your patient, we recommend performing a SCL monovision trial or trial frame demonstration, starting with the dominant eye for distance.

17. Have patient watch "Preparing for Surgery" LASIK or PRK consent video and answer all questions on the "Questions on LASIK/PRK Informed Consent Video" forms (if not available, patient can view at our office).
18. Ensure realistic expectations. Review material risks with patient and any risks they are more likely to experience based on your findings.
19. Give patient:
 - a. LASIK/PRK Patient Consent Form: Instruct patient to read consent form fully and initial, but DO NOT sign. Tell patient to BRING consent form to our Piikoi office on the surgical evaluation appointment (no faxed signatures please).
 - b. Review Consent for Co-Management after Eye Surgery form with patient where they will return to your office after the 1-day visit at the Piikoi office. This needs to be signed by the co-managing doctor and the patient.
20. Please quote the entire fee for the surgery.
21. When ready to schedule for surgery, please call our office for a surgical evaluation appointment and a separate preferred surgical date.
22. Please FAX the completed Pre-Operative Examination form to our Piikoi office at (808) 591-9909 at least 2 days prior to appointment.

If you do not have a pachymeter or have questions related to the candidacy of your patient, we are available to see them for a screening evaluation. Please complete the Pre-operative Examination form to the best of your ability and fax to our Piikoi office.

PRE-EVALUATION EXAMINATION AT JENKINS EYE CARE OFFICE

The following will be performed by the doctors at Jenkins Eye Care:

1. Personal information verification
2. Repeat manifest refraction
3. Pentacam topography
4. Pachymetry
5. Slit-lamp examination
6. Undilated fundus evaluation
7. Review surgery fee and payment - separate payments to Tyrie Jenkins, M.D., Inc., and co-managing doctor
8. Patient meets Dr. Jenkins if she is available
9. Detailed pre-operative instructions (e.g. no make-up, perfume, etc)
10. Prescriptions for antibiotic and steroid topical medications are given to the patient.
11. Surgical appointment confirmation will be faxed to the referring primary eye care doctor.

LASIK PRE- AND POST-OPERATIVE INSTRUCTIONS

Pre-operative

- An antibiotic drop is prescribed for the surgical eye(s) 3 days prior to surgery.
- Restasis is strongly recommended for patients to help reduce dry eye issues after surgery. We routinely prescribe Restasis for patients who experienced dryness with their contact lenses.

Post-operative

- The antibiotic is continued, and a steroid is added following surgery. At the 1-day post-op, both eye drops are continued for 1 week.
- Preservative-free lubricants are recommended QID or more in the first few weeks
- Eye shield needs to be worn following surgery until the next morning, and continue to be worn at night for the first week.
- Sunglasses with UV protection x 6 months
- Physical restrictions: no water activities (swimming, surfing, and hot tubs), no makeup, and no eye rubbing, avoid activities or areas that will cause irritation to their eyes.

PRK PRE- AND POST-OPERATIVE INSTRUCTIONS

Pre-operative

- An antibiotic drop is prescribed for the surgical eye(s) 3 days prior to surgery.
- Restasis is strongly recommended for patients to help reduce dry eye issues after surgery. We routinely prescribe Restasis for patients who experienced dryness with their contact lenses.

Post-operative

- BCL will be removed at our Piikoi office at 3-5 days post-op.
- The antibiotic is continued for 1 week after surgery
- Starting after surgery, add a steroid QID x 4 weeks, then taper over 2nd month (TID x 1 week, BID x 1 week, QD x 1 week). This steroid regimen may vary depending on patient's progress.
- Oral medications:
 - Neurontin 300mg TID x first 3 days
 - Vitamin C 1000mg/day or 500mg BID
- Preservative-free lubricants are recommended Q1-2 hours or more and Celluvisc QHS in the first few weeks.
- Eye shield needs to be worn the day of surgery until the next morning, and continue to be worn at night for the first week.
- Sunglasses with UV protection x 6 months
- Physical restrictions: no water activities (e.g. swimming, surfing, hot tubs, etc.), no makeup, and no eye rubbing, avoid activities or areas that will cause irritation to their eyes.

SCHEDULING

When you call to schedule a patient for LASIK/PRK surgery please let us know if you are co-managing this patient.

1. If co-managing, you will be doing the dilated pre-operative examination (this is preferred, please let us know if this is not an option)
2. If not co-managing and just referring the patient, please provide your patient's refractive and ocular health history (e.g. copies of their last exam). We will refer your patient back to you for annual exams after their refractive surgery.

NEIGHBOR ISLAND CO-MANAGEMENT

Dr. Jenkins works with neighbor island doctors interested in co-managing refractive surgery patients. If a patient chooses to have their surgery on Oahu, we will be happy to help with the arrangements. We frequently work with local hotels to arrange special rates for our neighbor island/out-of-town patients. Please contact us for the special code for these discounted rates.

Neighbor island patients will have their pre-evaluation exam and undergo surgery on the same day, followed by their one-day post-operative visit the next day. This schedule requires a one-night stay on Oahu.

FINANCING AND PAYMENT

The patient will be asked to pay the professional fees for the surgeon and co-managing doctor separately. For the patient's convenience, we can collect the fees for both parties with two separate checks, one written to the surgeon and the other to the co-managing doctor. Our office will mail that check to your office upon receipt. If the patient is paying with a charge card, we will charge for our portion and have the patient fill out a form acknowledging your fees to be charged by your office (or the patient can pay for the co-managing doctor fees directly at your office).

PLEASE NOTE THAT WE CANNOT COLLECT ONE CHECK AND LATER SUBMIT PAYMENT TO YOUR OFFICE.

Several financing options are available for your patient, should they choose to use them. Care Credit and Chase Health Advance both offer various financing plans.

PATIENT EXPERIENCE

LASIK

LASIK is performed in three steps: 1) flap creation with the femtosecond laser, 2) remodeling of the cornea underneath the flap with the excimer laser, then 3) flap reposition. The procedure is performed while the patient is awake and mobile; anesthetic eye drops are instilled and the patient is given a mild sedative (such as Valium).

In the laser room, the patient is asked to lie down on the bed positioned underneath the femtosecond laser. They will see a ring of lights. A corneal suction ring is applied to the eye, holding the eye in place. At this point, the patient will feel pressure and their vision will get dim or dark. This part of the procedure may cause a subconjunctival hemorrhage. Once the eye is immobilized, the flap is created - this part takes approximately 10 seconds. When the suction is released, the vision returns, but is blurry.

The patient is then positioned underneath the excimer laser. A speculum is used to hold the lids apart and the patient is asked to look at the green flashing lights. Surrounding them are four yellow lights, which by a process known as neurosensory tracking, helps prevent cyclotorsion. The flap is folded back and the patient's vision gets a bit blurrier.

The second step of the procedure is to use an excimer laser to remodel the corneal stroma. With the WaveLight® ALLEGRETTO WAVE® EYE-Q laser, treatment times are very rapid. The patient cannot see the laser but will hear the laser make a buzzing noise. They may also smell a very faint burning smell (although the excimer is a cool laser, this is just a bit of heat by-product).

After the laser has reshaped the stromal layer, the flap is carefully repositioned over the treatment area and checked for the presence of air bubbles, debris, and proper fit on the eye. The patient will see well instantly, however their vision will be a little foggy. About 15-30 minutes after surgery, the patient may have some tearing and burning which normally lasts about 3 – 4 hours. We advise that the patient go home and rest during that time.

PRK

Again, the procedure is performed with topical anesthetic eye drops. The patient is initially positioned underneath the excimer laser. A speculum is used to hold the lids apart, and a well is used to place a lake of diluted alcohol on the surface to loosen the epithelium. This portion takes approximately 30 seconds and the patient feels as if they are looking up from under water. The eye is then rinsed with cold balanced salt solution (BSS). The epithelium is removed with a blunt blade and the patient's vision is then blurry. They are asked to look at the flashing green lights and the treatment is done. Again, they may smell a faint burning smell. A circular sponge of mitomycin C is placed on the cornea for 12 seconds. The eye is again rinsed with BSS and an antibiotic drop and thick lubricating drop is placed in the eye along with a bandage contact lens. The patient should be able to see better right away. The anesthetic wears off in approximately 15 minutes and the patient may experience different levels of scratchiness and discomfort.

POST-OPERATIVE VISITS WITH PRIMARY CARE EYE DOCTORS

One week, 1 month, 3 months, and 6 months after LASIK surgery:

1. Review medications and lubricant use
2. Review symptoms
3. Test uncorrected visual acuity in surgery eye(s)
4. Manifest refraction
5. Slit lamp exam of cornea: evaluate flap and stromal interface
6. Review findings and make appropriate recommendations
7. Pre-appoint next visit
8. Fax post-op report to Piikoi office (808) 591-9909*

10-12 days post-op, 1 month, 2, 3, and 6 after PRK surgery:

1. Review medications and lubricant use
2. Review symptoms
3. Test uncorrected visual acuity in surgery eye(s)
4. Manifest refraction
5. Slit lamp exam of cornea
6. Review findings and make appropriate recommendations
7. Pre-appoint next visit
8. Fax post-op report to Piikoi office (808) 591-9909*

*The post-operative refraction results are very important to help us refine and update our nomogram. Please make sure to send us the one-month results.

POST-OPERATIVE VISITS AT JENKINS EYE CARE OFFICE

One day after LASIK surgery:

1. Review medications taken yesterday and today
2. Review symptoms after surgery
3. Test uncorrected visual acuity in surgery eye(s)
4. Slit lamp exam examination:
 - a. Flap evaluation
 - b. Stromal interface check, e.g debris, DLK
5. Review medications and physical restrictions
6. Ensure patient has appointment with co-managing doctor in 1 week
7. Fax post-op report (and surgical report if not done already) to co-managing doctor

One day after PRK surgery:

1. Review medications taken yesterday and today
2. Review symptoms after surgery
3. Test uncorrected visual acuity in surgery eye(s)
4. Slit lamp examination:
 - a. Evaluate cornea/corneal epithelium
 - b. Positioning of bandage SCL
5. Review medications and physical restrictions
6. Schedule appointment in 3-5 days to remove bandage SCL
7. Fax post-op report (and surgical report if not done already) to co-managing doctor

Four days after PRK surgery:

1. Review medications
2. Review symptoms since last visit
3. Test uncorrected visual acuity in surgery eye(s)
4. Slit lamp examination:
 - a. If completely re-epithelialized, remove bandage SCL and schedule appointment with co-managing doctor in 1 week.
 - b. If not completely re-epithelialized, leave bandage SCL and return to office in 1-3 days to recheck on epithelium. Remove and replace if SCL heavily deposited or warrants removal, being careful not to disrupt healing epithelium.
5. Review medications to be taken until the next scheduled visit
6. Fax post-op report (and surgical report if not done already) to co-managing doctor

LASIK POST-OPERATIVE CARE AND COMPLICATIONS

Discomfort/Pain: Normally there is some irritation immediately after surgery, but it improves substantially by the next day. Rest, cold compresses and taking OTC pain medications are the best methods to cope with mild to moderate discomfort. If there is persistent pain, look for flap slippage or dislodgement.

Infection: Infections are rare with LASIK since intra-operative sterile techniques are observed. A broad-spectrum antibiotic will be prescribed for both pre- and post-op use. To reduce risk of contamination, the patient should not wear eye makeup for 1 week after surgery. The patient will also be restricted from non-hygienic environments (e.g. swimming pool, hot tub). If an infection does occur, white infiltrates may be seen on the slit lamp. Aggressive topical antibiotics may be needed for adequate management.

Diffuse Lamellar Keratitis (DLK): This is caused by inflammation in the stromal bed from unknown causes in many situations. Slit lamp findings will reveal diffuse or localized white fine granular particles in the interface. Treatment is with frequent dosing of topical steroids (e.g. Pred Forte or Durezol).

Interface Debris: Debris in the interface needs to be monitor, but may not need intervention unless it is causing inflammation.

Central Toxic Keratopathy (CTK): CTK is caused by a toxic reaction in the stromal bed. It presents as a focal white lesion within the cornea associated with cornea striae during first few days after LASIK (day 4-5) and it is only visible behind the slit lamp. It is usually associated with a hyperopic shift. This is not due to an inflammatory condition, so it will not be responsive to steroids. Fortunately, it is self-limiting and resolves after 6-9 months.

Dry Eyes: Dry eye is a common finding after LASIK. While most cases of dry eye resolve over the first few weeks to months, few persist beyond six months. If a patient has dry eyes prior to surgery, they should be treated with lubricants or prescription medications (e.g. Restasis) until SPK is not seen on the cornea and tear film integrity is re-established. After LASIK, the patient is

instructed to continue Restasis for a few months after surgery. Other treatments such as OTC lubricants, gels and punctal plugs can also help with temporary dry eyes. Oral fish or flax seed oil supplements (2000mg/day) have been reported to stabilize tear film as well. Fortunately, most dry eyes are self-limiting and improve as the corneal nerves regenerate in 6-12 months.

Flap Edema: It is expected to have some corneal flap edema at 1-day which should resolve without complication. If there is significant corneal edema, Muro 128 ointment may be recommended for night time use.

Corneal Striae: At 1-day, fine folds in the corneal flap may be from micro slippage of the flap or “tenting effect” in high myopic treatments. If the best corrected vision is good and the striae is away from the visual axis, only observation is needed. If the striae is causing loss in best corrected vision, contact the surgeon who may elect to re-lift the flap as soon as possible.

Dislocated/Dislodged Flap: This is usually noticed within the first 24 hours from accidental contact to the flap. The patient will notice increased discomfort and decrease in vision immediate after the event. The flap needs to be re-lifted, re-positioned and smoothed out with bandage CL to promote better adherence. If the trauma that caused the flap movement was significant, a dilated retinal exam is indicated.

Epithelial Ingrowth: Epithelial ingrowth may be seen at 1-week and is caused by epithelial cells that have gained access to the stromal bed. This is rare in primary treatments and more common in retreatments when the flap has been lifted. The ingrowth may be located in any position, but most are at the peripheral flap edge. If the ingrowth disturbs the visual axis or if there is documented progression, it may need to be removed after re-lifting the flap. Otherwise stationary ingrowth at the edge of the flap can be monitored.

Corneal Dystrophy: If the patient presents with small stromal opacities pre-operatively, rule out the presence of granular, lattice or Avellino corneal dystrophies. There is clinical evidence indicating corneal laser treatment in these patients aggravates the condition to result in more stromal opacities months post-operatively. Corneal dystrophies are contraindicated for corneal laser surgery.

Under or Overcorrection: Under or overcorrection usually becomes apparent fairly soon after surgery but enhancement can only be performed when the cornea stabilizes, which may take up to three months. If the original treatment was quite high it is not uncommon for the prescription to fluctuate in the first few months. Reassure the patient that once the cornea is stabilized and the refractive error is stable, an enhancement can be done in most cases with a flap re-lift. For patients with a high correction, verify there is enough corneal thickness for this touch up.

Glare and Halos: Short term glare and halo are expected in most patients right after surgery due to corneal and flap edema. This usually resolves within weeks to months. Persistent night halos and glare is more likely in moderate to high myopes after treatment. This can be related to many factors including larger pupils in dim lighting and larger amounts of ablation. The use of larger optical zones with blending has decreased the incidence of glare and halos. Counsel your moderate to high myopic patients with large pupils that glare and halo may be permanent, and if that is a concern to them, recommend either no surgery or another surgical option (e.g. Visian or refractive lens exchange).

If you have a patient who does experience persistent glare and halo at night after LASIK, you can consider correcting any residual Rx with glasses and AR coating. You can also trial medications such as Alphagan P that has pupil-constricting properties. The best way to avoid post-LASIK glare and halos in your patients is proper screening and setting realistic expectations.

Corneal Ectasia: Iatrogenic ectasia results when the cornea becomes too thin and the patient's vision fluctuates with diurnal IOP changes throughout the day. These unfortunate cases were more likely when LASIK was inadvertently performed on patients who may have had undiagnosed early forms of keratoconus or pellucid marginal degeneration, due to older diagnostic technology. With the advent of new corneal topographers (e.g. Pentacam, Orbscan, Visante) which now allow us to measure both the front and back surface corneal curvature/thickness, we are much more likely to identify these cases and recommend against surgery. Another major change in protocol that should reduce the risk of ectasia is the change

in guidelines for the amount of tissue removed with the excimer laser. Previously the FDA recommended maximum treatment amounts down to 250 microns in the stromal bed but now we only treat down to 300 microns. This more conservative approach should reduce the incidence of post-LASIK ectasia.

Loss of Best Corrected Acuity: Although very rare, this can occur. A full analysis of the possible cause of the reduced acuity includes a thorough dilated exam, corneal topography and macular/retinal scan. Rule out any disease factors such as cataracts, macular disease, dry eyes, etc.

PRK POST-OPERATIVE CARE AND COMPLICATIONS

Discomfort/Pain: Compared to LASIK, PRK patients may feel more discomfort in the first 3-5 days post-operatively and mild irritation for the remainder of the first week. Patients are given a prescription for Neurontin to take post-operatively to ameliorate corneal sensation in the first 3 days. They may also take OTC pain medications as needed. If there is persistent pain, the patient can call our office and we can write a prescription for a narcotic.

Bandage Contact Lens: The patient will have a bandage contact lens (BCL) on the PRK treated eye for the first 3-5 days after surgery. Once the epithelium is completely healed, the BCL is removed. Patients may notice irritation from the BCL after a few days due to buildup. If the irritation is too bothersome, a new BCL can be inserted (being care not to disturb the healing epithelium). If the BCL inadvertently falls off, the patient will experience some discomfort and should have a new BCL inserted (this could be done at the co-managing doctor's office or our Piikoi office, depending on patient convenience).

Infection: Infections are rare in PRK since intra-operative sterile techniques are observed. A broad-spectrum antibiotic will be prescribed for both pre- and post-op use. To reduce risk of contamination, the patient should not wear eye makeup for 1 week after surgery. The patient will also be restricted from non-hygienic environments (e.g. swimming pool, hot tub). If an

infection does occur, white infiltrates may be seen on the slit lamp. Aggressive topical antibiotics may be needed for adequate management.

Stromal Haze: Stromal haze is the vision-threatening complication associated with PRK. The risk of haze has been significantly reduced with the current use of Mitomycin-C for those with moderately high to high treatments, and all secondary PRK procedures. To further limit haze, a topical steroid is initiated from day 1 post-op onwards (with the bandage SCL). Appropriate topical steroid use is the best defense against corneal haze, so do not discontinue steroid use earlier than prescribed (and emphasize this fact to your patient).

Dry Eyes: Dry eye is less common after PRK versus LASIK. Patients with a significantly higher risk of dry eyes due to pre-existing conditions and high myopic correction should consider PRK as a better alternative compared to LASIK.

Under or overcorrection: Over-correction during the early stages of PRK healing is to be expected. As the steroid use is tapered, the refraction will tend to drift favorably. Please advise your PRK patients that they need to be patient with their vision, since their resultant vision may take 3 months or longer to stabilize.

Glare and Halos: Short term glare and halo are expected in most patients right after surgery but this will resolve as corneal edema and any stromal haze subsides. This usually resolves within a few months. Persistent night time halos and glare is more likely in moderate to high myopes after treatment. This can be related to many factors including larger pupils in dim lighting and larger amounts of ablation. The use of larger optical zones with blending has decreased the incidence of glare and halos. Counsel your moderate to high myopic patients with large pupils that glare and halo may be permanent and if that is a concern to them, recommend either no surgery or another surgical option (e.g. implantable IOL).

If you have a patient who does experience persistent glare and halo at night after PRK, you can consider correcting any residual Rx with glasses and AR coating. You can also trial medications such as pilocarpine or Alphagan P that has pupil constricting properties. The best way to avoid

long-term post-operative glare and halos in your patients is proper screening and setting realistic expectations.

Loss of Best Corrected Acuity: Although very rare, this can occur. A full analysis of the possible cause of the reduced acuity includes a thorough dilated exam, corneal topography and macular/retinal scan. Rule out any disease factors such as cataracts, macular disease, dry eyes, etc.

CONCLUSION

LASIK and PRK surgeries are extremely successful procedures and complications are rare. The vast majority of our patients are overjoyed with the new-found freedom afforded them. Unfortunately, a small percentage of patients do experience complications. In order to appropriately manage these complications, communication between the surgeon and co-managing doctor's office is paramount. The co-managing doctor following the patient should be available at all times to answer the patient's questions and to see the patient on an emergency basis. Dr. Jenkins, and Dr. Ueda will be available at all times a for consultation with you, and if needed to see the patient at your request. Please let us know if you have any questions regarding a patient's post-operative course. We look forward to working with you, your office and your patients.

IMPORTANT CONTACT INFORMATION



JENKINS EYE CARE

808-591-9911 (Day - Office)

855-522-2020 (Toll Free)

808-524-2575 (Physicians' Exchange after-hours)

808-591-9909 (Fax)

E-mail Addresses:

Dr. Tyrie Jenkins: tyrilee@gmail.com

Dr. Jeffrey Peterson: drpeterson@jenkinseyecare.com

Dr. Jacqueline Ueda: jtueda@jenkinseyecare.com