

**Eye Care Skills: Presentations for Physicians  
and Other Health Care Professionals** Version 3.0

# Refractive Surgery

**Speaker Notes**

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# A GUIDE TO PRESENTING

## Refractive Surgery

About half of the U.S. population have refractive errors—nearsightedness, farsightedness, and astigmatism. Some 150 million are thought to wear eyeglasses or contact lenses to correct them. Between 1995 and 2001, more than 2 million of those underwent refractive surgery. *Refractive Surgery* provides primary care physicians with an overview of this dynamic and rapidly expanding area of ophthalmologic care.

This program refreshes the primary care physician’s knowledge of the principal forms of refractive error, including age-related presbyopia. It describes the clinical criteria and methods for evaluating patients considering refractive surgery; optimum ocular health is critical to successful refractive surgery, and certain systemic conditions (for example, diabetes, rheumatoid arthritis, lupus, and Sjögren’s syndrome) may greatly affect the function of the eye as well as wound healing.

The importance of determining each refractive candidate’s individual visual needs, based on occupational and recreational activities, is stressed, as is communication between patient and physician. Learning a patient’s expectations is paramount for a successful refractive outcome. Patients with unrealistic expectations for “perfect” vision may be disappointed in what might otherwise be considered a successful refractive surgery. It is important that every patient understand that not every person reacts the same way, even in the best of clinical circumstances, and that a specific refractive outcome cannot be guaranteed for any individual.

Finally, the various forms of refractive procedures most in use today are described in detail. These include older, original forms of incisional corneal surgery, such as radial keratotomy (RK) and arcuate keratotomy (AK); corneal inserts; the highly popular photoablative procedures employing lasers, including LASIK, LASEK, and photorefractive keratectomy (PRK); conductive keratoplasty (CK); and intraocular surgery, including intraocular lens implantation and natural lens replacement. The clinical procedures are described and the advantages and disadvantages of each type of procedure are reviewed.

With the explosion in popularity of elective surgery to correct refractive error, *Refractive Surgery* is a valuable resource for today’s primary care physicians, who are often called upon to initially advise and counsel patients considering these corrective methods.

### Approximate Running Time

35–45 minutes

### Suggested Audience

- Internists
- Family physicians
- Occupational health-care practitioners
- Medical students, interns, and residents

# INTRODUCTION

SLIDE

1

Refractive eye surgeries have become enormously popular worldwide. About half of the U.S. population has refractive errors, which include nearsightedness, farsightedness, and astigmatism, and as many as 150 million are thought to wear eyeglasses or contact lenses to correct them. Between 1995 and 2001, some 2.3 million of those underwent refractive surgery.

SLIDE

2

Although numerous types of surgical and laser refractive procedures are available today, a procedure known as laser in situ keratomileusis (LASIK) to correct nearsightedness is currently the most common type. Word of mouth from satisfied patients undergoing LASIK in particular has contributed to the popularity of this elective surgery. The safety and success rates for this and many other common refractive procedures are well documented. For example, LASIK has been shown to improve vision to 20/20 in 79% to 93.5% nearsighted individuals with low to moderate nearsightedness (approximately 16 diopters or less). However, because the science is young and newer procedures are constantly surfacing, long-term outcomes of refractive surgery are not yet fully known. As with all surgical procedures, refractive surgeries have risks and drawbacks associated with them.

Introduction

## REFRACTIVE ERROR AND SURGERIES IN THE UNITED STATES

- 150 million wear eyeglasses or contact lenses
- 2.3 million refractive surgeries performed between 1995 and 2001

Introduction

## REFRACTIVE SURGERY: POPULARITY, EFFICACY, SAFETY

- LASIK (laser in situ keratomileusis) currently most performed procedure
- LASIK improves vision to 20/20 in up to 93.5% of patients with low to moderate nearsightedness
- Long-term outcomes of refractive surgery as yet unavailable

SLIDE

3

With the ubiquity of refractive surgery, primary care physicians and other primary caregivers need to be aware of the corrective options offered to their patients and, especially, the contraindications and complications of these procedures, so that they can appropriately participate in their patients' care.

Introduction

**Primary care physicians' understanding of refractive procedures helps ensure quality patient care.**

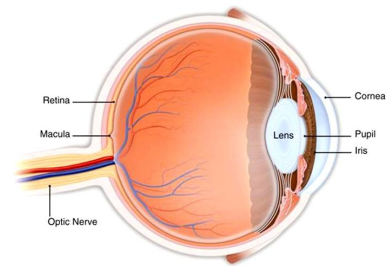
## REFRACTIVE ERRORS

SLIDE

4

Light rays enter the eye through the clear cornea, pupil, and lens. The rays are focused directly onto the retina, which converts the rays into impulses sent through the optic nerve to the brain, where they are recognized and perceived as images. 70% of the eye's focusing power comes from the cornea, and 30% from the lens.

Refractive Errors



The human eye

SLIDE

5

In an otherwise healthy eye, conditions that prevent images from clearly focusing on the retina are known as “refractive errors.” These include myopia (nearsightedness), hyperopia (farsightedness), and astigmatism (an irregularly shaped cornea that results in blurred vision). With age, the eye's lens loses its flexibility and ability to help focus light, resulting in a condition called presbyopia.

Refractive Errors

### REFRACTIVE ERRORS

- Myopia—nearsightedness
- Hyperopia – farsightedness
- Astigmatism—irregularly shaped cornea, causing blurred vision
- Presbyopia—age-related loss of lens flexibility, causing reduced near vision

SLIDE

6

In myopia (nearsightedness) the image is focused in front of the retina instead of on it. Myopic patients can see images clearly up close, but not in the distance. High myopes need to hold things very close to get clear images. Myopes generally have eyes with a longer axial length, or larger globes. They also have a higher incidence of retinal detachment. Refractive surgery is most predictably successful in those with mild to moderate myopia (up to approximately !6 diopters), although those with severe myopia can experience significant vision improvements.

SLIDE

7

In hyperopia (farsightedness), the image is focused behind the retina. If the hyperopia is mild (less than approximately +2 diopters), patients are able to focus to bring images into clear view. Higher hyperopes are not able to see any images clearly, near or far. These patients generally have shorter axial lengths, or smaller eyes. They have a higher incidence of narrow-angle glaucoma. Refractive surgery for hyperopia is slightly less predictable and takes longer to stabilize as compared to myopia.

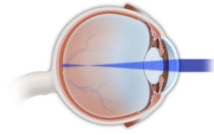
SLIDE

8

Astigmatism is the state in which the refractive power is not uniform in all meridians of the cornea, resulting in light rays focusing at different points. The effect blurs the retinal image. The shape of the normal corneal surface is a spherical curve, but the cornea in the eye with astigmatism is shaped more like a football.

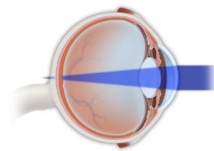
### MYOPIA (NEARSIGHTEDNESS)

- Images focus in front of retina
- Severity is related to success of refractive surgery



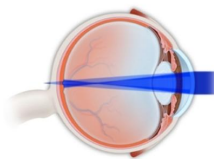
### HYPEROPIA (FARSIGHTEDNESS)

- Images focus behind the retina
- Renders refractive surgery less predictable, requires longer to stabilize



### ASTIGMATISM (BLURRED VISION)

- Uneven curvature of cornea
- Causes separate areas of focus and consequent blurring



SLIDE

9

Presbyopia is the term describing a loss of accommodation, or the loss of the lens’s focusing ability. This occurs gradually, as the lens loses plasticity with age, and generally becomes symptomatic in the fifth decade of life. People with presbyopia are unable to focus on near objects. Refractive surgery today cannot halt or mitigate the progress of presbyopia of the natural lens, although certain other techniques, such as monovision or multifocal or accommodative intraocular lens implants, may help alleviate many of the functional issues related to presbyopia.

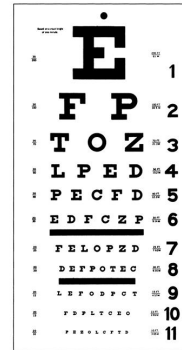
SLIDE

10

Visual acuity is the main measure of eyesight. It is essentially a measure of the eye’s resolution. Snellen acuity, the most common measurement scale, is familiar as the “big E” chart (shown). The 20/20 level means a person can discriminate a certain size letter at 20 feet, whereas 20/40 vision means that a patient must be at 20 feet to see what a person with normal vision could see at 40 feet.

### PRESBYOPIA (LOSS OF FOCUSING ABILITY)

- Loss of accommodation with age
- Manifests in early 40s
- Cannot be halted or mitigated with refractive surgery



Snellen visual acuity chart



# PRESURGICAL EVALUATION

## Ocular and Systemic Health

SLIDE

11

In addition to the specific focusing mechanisms of the eye, other physiologic factors as well as disease states can affect visual acuity. Candidates for refractive surgery must have sound total eye health—from tear film to the central nervous system—to enable a successful outcome. Refractive surgery corrects only problems related to image focus. Patients with certain ocular and systemic conditions do not make good candidates for these procedures, unless these conditions can be ameliorated before the surgery is performed.

SLIDE

12

A healthy tear film is paramount to clear vision. The tear film is responsible for approximately 60% of the refracting ability of the eye. Any irregularities or deficiencies in the tear film can result in profound decrease in acuity as well as great discomfort for the patient.

The two most common tear film problems result in dry eye and blepharitis. Dry eye is a tear-deficient state with a multitude of etiologies. Blepharitis is inflammation of the eyelid, which also has many causes, from bacteriologic to mechanical. Patients frequently describe “burning” as the predominant symptom. These conditions must be treated before refractive surgery to ensure a positive outcome.

Presurgical Evaluation

### SCREENING CANDIDATES FOR REFRACTIVE SURGERY

- Success relies on sound total eye health
- Ameliorate correctable ocular disorders prior to surgery

Presurgical Evaluation

### DISORDERS OF TEAR FILM AFFECTING REFRACTION

- Dry eye
  - Watery or dry eyes, visual fluctuation
- Blepharitis (shown)
  - Burning, watering



SLIDE

13

Aside from astigmatism, other disorders affecting the shape or clarity of the cornea will affect visual acuity. One of these, keratoconus, is a noninflammatory progressive ectasia of the cornea resulting in progressive thinning and steepening of the corneal surface. In advanced cases of keratoconus, the cornea becomes cone shaped, as seen here in side view. Refractive surgical procedures that include altering the shape of the cornea are not recommended in patients with keratoconus because these procedures thin the cornea even more, adding to the risk of ectasia. Much of the refractive surgery prescreening process is devoted to detecting early forms of keratoconus. Patients with this condition may seek refractive surgery because they have always had a high need for contact lenses or glasses.

SLIDE

14

Any corneal opacity resulting from trauma, infection, or inflammation may limit visual acuity even after refractive surgery. A form of laser surgery, phototherapeutic keratectomy, may decrease corneal scarring in some instances.

Presurgical Evaluation

### CORNEAL DISORDERS AFFECTING ACUITY: KERATOCONUS



Presurgical Evaluation

### CORNEAL DISORDERS AFFECTING ACUITY: CORNEAL SCARRING



SLIDE

15

The iris configuration determines how much light enters the eye. It dilates in low illumination to let more light into the eye and constricts in greater illumination to decrease light input to the retina. Patients should be aware that defects or irregularities in the iris may result in blurring or multiple images. Very large pupils may cause problems with refractive surgery patients, resulting in halos or glare.

SLIDE

16

A cataract is an opacity of the crystalline lens. Cataracts have many causes but most commonly are a result of aging. Corneal surface procedures are not recommended as refractive surgery in patients with visually significant cataract. Lens extraction and placement of an intraocular lens can potentially improve the refractive state as well as overcome the effect of cataract.

SLIDE

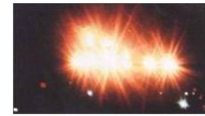
17

Retinal disorders are often the limiting factor in a patient's visual acuity and are not helped with refractive surgery. Patients may have a perfectly clear and focused refractive status of the eye but with retinal disease still will not get a clear image. Uncontrolled diabetes can cause macular edema and is a frequent culprit. Prior retinal detachment, retinal infection, scarring, or age-related macular degeneration are also common diseases limiting acuity and, therefore, refractive surgery.

Presurgical Evaluation

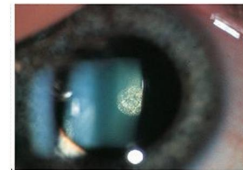
### IRIS AND PUPIL CONDITIONS AFFECTING ACUITY

- Iris defects may cause blurring or multiple images
- Large pupils may lead to the appearance of postsurgical glare (top) or halos (bottom)



Presurgical Evaluation

### LENS DISORDERS AFFECTING ACUITY



Cataract seen through pupil as a white opacity

Presurgical Evaluation

### RETINAL DISORDERS AFFECTING ACUITY

- Diabetic retinopathy
- Retinal detachment
- Cystoid macular edema
- Retinal scar
- Age-related macular degeneration

A patient can have anatomically normal eyes and still have poor acuity if a problem exists in the optic nerve or brain.

Amblyopia, for example, most commonly results from deficient formation of some of the elements of visual processing at an early age. Left untreated past childhood, amblyopia is irreversible and permanently limits visual acuity. Likewise, any disease of the optic nerve, visual pathway or visual cortex (ie, from ischemia) may result in permanent loss of acuity or visual field. Although these disorders are not absolute contraindications to refractive procedures, patients must be carefully counseled about their limited visual potential.

## CNS DISORDERS AFFECTING ACUITY

- Amblyopia
- Disorders of visual cortex
- Ischemia

## Patient Evaluation

The evaluation of a patient for refractive surgery is an in-depth and lengthy process involving a careful interview, ocular examination, and various types of ancillary testing.

## PATIENT EVALUATION FOR REFRACTIVE PROCEDURE

- Comprehensive process requiring excellent doctor-patient communication
  - Preoperative interview
  - Examination
  - Ancillary testing

Learning a patient's expectations is paramount for a successful refractive outcome. Patients with unrealistic expectations for "perfect" vision are not good candidates for refractive surgery. Managing patients' expectations begins with offering good communication and information. It is important that every patient understand that not every person reacts to refractive surgery the same way, even in the best of hands. A specific refractive outcome cannot be guaranteed for any individual.

## PREOPERATIVE EXAMINATION: PATIENT EXPECTATIONS

- Possibly most important predictor of surgical "success"
- Patients demanding "perfect vision" not good candidates

**SLIDE****21**

Care must be taken to understand a patient's occupational and recreational activities, because these can indicate the types of refractive targets that the patient must be able to resolve clearly. Not everyone functions best with 20/20 distance vision in each eye. For example, a presbyopic school teacher may want functional vision both at near, to read notes, and at distance, to read a chalkboard or poster; in this case, one eye can be targeted for near vision and one eye for distance. However, a young athlete would be best served with both eyes targeted for distance.

**SLIDE****22**

A complete medical history should be taken for any refractive surgical procedure. Systemic diseases such as diabetes, rheumatoid arthritis, lupus, or Sjögren's syndrome may greatly affect the function of the eye as well as postsurgical wound healing. A poor healing response or scarring can be devastating to vision. It is generally not recommended to perform elective refractive procedures on patients with advanced AIDS or on women who are pregnant or nursing.

**SLIDE****23**

Several pharmacologic therapies have been deemed by the FDA to be contraindicated in the popular refractive surgery known as LASIK, including isotretinoin (Accutane), sumatriptan succinate (Imitrex), and amiodarone due to influences on the cornea. Other systemic medicines may influence pupil size or contribute to dry eye states, such as antihistamines. Anticoagulants may need to be discontinued for intraocular procedures.

### PREOPERATIVE EXAMINATION: SOCIAL HISTORY

- Visual needs of work or play: Needs of a teacher versus a young baseball player versus a middle-aged golfer/accountant

### PREOPERATIVE EXAMINATION: MEDICAL HISTORY

- Systemic diseases may compromise success
  - Diabetes
  - Collagen vascular (rheumatoid arthritis, lupus, Sjögren's)
  - Immunosuppression
  - Pregnancy/nursing contraindicate procedure

### PREOPERATIVE EXAMINATION: MEDICINES

- Contraindicated for LASIK
  - Accutane
  - Imitrex
  - Amiodarone
- Other medicines with possible effects
  - Antihistamines
  - ± Anticoagulants?

A careful ocular history is elicited. Pattern and type of contact lens wear is very important. False measurement and refractive shifts may occur if patients have not discontinued wearing their contact lenses long enough before preoperative measurements and surgery. This may result in a false target and poor outcome. Generally it is recommended that patients discontinue wearing soft lenses for 2 weeks and hard lenses (RGPs) for 3–6 weeks, or until the refraction is stable. A history of ocular trauma, surgery, glaucoma, ocular herpes infection, or genetic ocular disease may influence surgical planning.

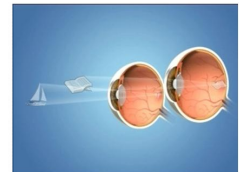
Patients should understand that almost everyone will eventually become presbyopic and need reading glasses. Although technologies and techniques are available to aid with presbyopia, it has no “cure.” Relative to refractive surgery, the term “monovision” denotes targeting the refraction of one eye for distance and one eye for near vision. This technique may be offered particularly to patients with presbyopia. Although it does not give the sharpness of vision possible when both eyes are targeted for distance, it gives greater range of vision and may decrease the need for glasses. Up to 85% of people can tolerate this, but patients should be given a trial with a contact lens before a permanent procedure is performed. The dominant eye is usually set for distance. Monovision may not be a good choice for patients who need very sharp distance vision in both eyes for their work or hobbies.

### PREOPERATIVE EXAMINATION: OCULAR HISTORY

- Contact lens wear
- Trauma
- Previous surgery
- Glaucoma
- Ocular HSV
- Family history

### PREOPERATIVE EXAMINATION: MONOVISION POSSIBLE?

- Tolerated by 85% of population with up to several weeks' adjustment period
- Contact lens trial before procedure
- Can be used in a variety of refractive procedures
- One eye (dominant) set for distance and one eye set for near or intermediate (as shown)



SLIDE  
**26**

Prior to refractive surgery, a complete ocular exam is performed. This includes visual acuity, pupil exam, ocular motility, confrontation visual fields, intraocular pressure, slit-lamp exam, and dilated fundus exam.

SLIDE  
**27**

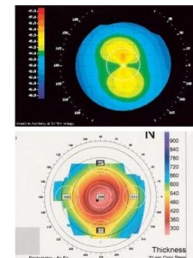
A variety of ancillary tests provide key information vital to improving surgical success. Corneal topography determines the curvature and refractive power of the cornea. Pachymetry measures the corneal thickness. If too thin, a corneal ablative procedure may not be a good choice. Wavefront analysis measures the properties of light entering and exiting the eye to map the patient's individual refractive properties and aberrations. Ultrasound and interferometry are used in determining the needed refractive power of intraocular lenses.

**PREOPERATIVE EXAMINATION:  
OCULAR EXAMINATION**

- Visual acuity
- Pupil exam
- Ocular motility
- Confrontation visual fields
- Intraocular pressure
- Slit-lamp exam
- Dilated fundus exam

**PREOPERATIVE EXAMINATION:  
ANCILLARY TESTING**

- Corneal topography (as shown on top)
- Pachymetry (as shown on bottom)
- Wavefront analysis
- Ultrasound/interferometry to measure axial length



# REFRACTIVE PROCEDURES

SLIDE

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Various approaches exist for correcting refractive error. These include incisional corneal surgery (eg, radial or arcuate keratotomy—RK or AK); corneal inserts (eg, Intacs); photoablation (eg, LASIK, LASEK, and photorefractive keratectomy—PRK); conductive keratoplasty; and intraocular surgery (eg, intraocular lens implantation and natural lens replacement). Depending on the patient's visual needs and physiologic characteristics, several approaches may be possible. Some procedures have proven safer and given better visual results depending on a patient's refraction and physiology.

Refractive Procedures

## PROCEDURES IN REFRACTIVE SURGERY

- Incisional corneal surgery
  - RK, AK
- Corneal inserts
  - Intacs
- Photoablative procedures
  - LASIK, LASEK, PRK
- Conductive keratoplasty
- Intraocular surgery
  - Phakic IOLs
  - Natural lens replacement

## Incisional Corneal Procedures—RK and AK

SLIDE

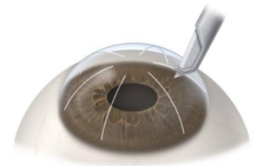
29

Radial keratotomy (RK) was developed in the 1970s and for a time was thought to be the best refractive technique. In RK, a blade at a fixed depth is used to create incisions that sever collagen fibers in corneal stroma. Multiple radial cuts are applied based on a nomogram. Wound gape increases curvature in the central cornea, decreasing effective power, and correcting mild to moderate myopia. Although versions of RK still have use today, in general safer and more stable refractive procedures have replaced it.

Refractive Procedures

## RADIAL KERATOTOMY (RK)

- Developed in the 1970s
- Multiple radial cuts into corneal stroma to correct mild to moderate myopia
- No longer the most popular, safest, or most stable refractive procedure





SLIDE  
**30**

Long-term stability of RK has been a problem. Changes in refraction over time are common. Patients may experience dehiscence of radial keratotomy scars as a result of blunt trauma, or may have reduced vision and glare from corneal irregularities.

SLIDE  
**31**

Arcuate keratotomy (AK) uses the same principles as RK (except incisions are made tangentially), and it carries the same risks. AK can be used to refine mild to moderate amounts of astigmatism not corrected by other procedures. The procedure is generally quick, with little pain, and may be done under topical anesthesia. As with radial keratotomy, arcuate keratotomy is not performed very much as a refractive procedure at the present time, although it is sometimes used at the same time as cataract surgery to reduce astigmatism.

## Corneal Inserts

SLIDE  
**32**

Intrastromal corneal rings, or Intacs, are polymethylmethacrylate (PMMA) rings placed in the corneal stroma to flatten the corneal surface, effectively decreasing the power of the cornea and improving myopia. They have been used with some success in the treatment of low to moderate myopia. The corneal rings can be removed or exchanged if needed.

### RADIAL KERATOTOMY (RK): COMPLICATIONS

- Lack of stability—refractive fluctuations and shifts
- Complications
  - Irregular astigmatism
  - Glare
  - Wound dehiscence

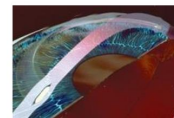
### ARCUATE KERATOTOMY (AK)

- Tangential incisions in cornea used to correct astigmatism
- Same risks as RK
- Often used in conjunction with cataract surgery

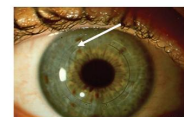


### INTRASTROMAL CORNEAL RINGS (INTACS)

- Circular rings of polymethylmethacrylate (PMMA) placed in mid peripheral stroma
- Treats low myopia
- Removable/exchangeable



Cross section of cornea with INTACS



Vertical placement of INTACS

# Photoablative Procedures

SLIDE

33

Photoablative procedures include all procedures using laser light to ablate, or reshape, the cornea, thereby changing the power and refraction to a desired state. The excimer laser, short for “excited dimmer” laser, emits laser radiation with a wavelength of 193nm and allows precise removal of tissue without thermal penetration. It can essentially remove one cell layer at a time in any configuration desired. This makes it useful for a variety of procedures, including PRK, LASIK, LASEK, and others.

## PRK

SLIDE

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Photorefractive keratectomy (PRK) represents the first generation of excimer laser procedures and still proves very useful and effective. PRK is performed using topical anesthesia with eye drops. To ablate the corneal stroma into the desired pattern the epithelium must first be removed. An alcohol solution is frequently used to loosen the epithelium so it debrides easily. The laser light is delivered and a bandage contact lens is placed to aid healing and pain control. The corneal epithelium then heals under the contact lens, which can be removed in a few days.

Refractive Procedures

## PHOTOABLATIVE PROCEDURES

- Excimer (“excited dimer”) laser
  - Allows precise removal of corneal tissue
  - Pattern can be “customized”
- Used for PRK, LASEK, LASIK



Refractive Procedures

## PHOTOREFRACTIVE KERATECTOMY (PRK): PROCEDURE

- Alcohol placed to loosen epithelium
- Central epithelium debrided
- Laser ablation
- Epithelium grows back from periphery under bandage contact lens

SLIDE  
**35**

PRK does not involve corneal flap construction (as with LASIK and LASEK, described later) and, consequently, obviates associated complication. It is stable and can be performed on a thin cornea. Its disadvantages include more discomfort than with some other procedures; the inconvenience of being performed one eye at a time, in two different surgical sessions; a slightly higher risk of infection; and a risk of haze (which may be minimized with the use of mitomycin C). It must be stressed to the patient that while possibly safer in some aspects than the highly popular LASIK procedure, PRK requires a longer healing period before vision returns, and patients frequently have discomfort for a few days after the surgery.

**PRK: ADVANTAGES AND DISADVANTAGES**

- Advantages
  - No corneal flap complications
  - Long-term stability
  - Can perform on thin cornea
- Disadvantages
  - More patient discomfort
  - Inconvenience: usually done one eye at a time
  - Slightly higher risk of infection
  - Risk of haze (mitomycin C may minimize)
  - Glare/halos

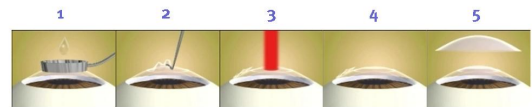
**LASEK**

SLIDE  
**36**

Another version of a surface procedure that has gained widespread use in the past few years is laser subepithelial keratomileusis, or LASEK. Rather than removing the corneal epithelium as in PRK, LASEK involves loosening the epithelium with alcohol, carefully rolling it back, treating the underlying surface with the laser, then replacing the sheet of epithelium back over the cornea. A bandage contact lens again is used for a short time. If the epithelium remains healthy this can aid with pain control and potentially faster visual recovery; if not, it may be removed and the procedure then resembles a PRK.

**LASER SUBEPITHELIAL KERATOMILEUSIS (LASEK): PROCEDURE**

1. Alcohol used to loosen epithelium
2. Epithelium carefully rolled back
3. Laser ablation of underlying surface
4. Tissue removed by laser
5. Epithelium replaced and protected with bandage contact lens



SLIDE

37

As with PRK, LASEK can be performed on a thin cornea. The repositioned epithelium helps reduce postoperative pain. The biggest disadvantage is that it takes several weeks for the eye to heal well and see well, and the surgery is usually performed one eye at a time.

Refractive Procedures

### LASEK: ADVANTAGES AND DISADVANTAGES

- Advantages
  - Same as PRK
  - Epithelial flap replacement helps with post-op pain
- Disadvantages
  - Inconvenient: usually performed one eye at a time
  - Same risks as PRK
  - Glare/halos

## Lasik

SLIDE

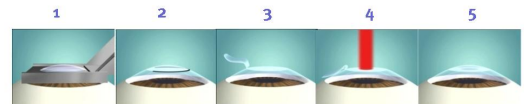
38

LASIK is the most common refractive procedure, accounting for 90% of all surgeries. Its popularity stems from the quick visual recovery and relatively low discomfort experienced by most patients. After administration of a topic ocular anesthetic, a suction ring stabilizes the globe while a microkeratome cuts a thin stromal flap. The flap is reflected back and the laser energy delivered, reshaping the cornea. The flap is reflected back into position and hydrostatic forces created by the pump mechanism seal the flap back down.

Refractive Procedures

### LASER IN SITU KERATOMILEUSIS (LASIK): PROCEDURE

1. Suction ring stabilizes globe
2. Microkeratome creates thin stromal flap with a hinge
3. Flap reflected back
4. Laser ablation sculpts cornea
5. Stromal flap replaced



The advantage of LASIK is that patients have a quick visual recovery with little discomfort. It offers long-term stability. Disadvantages include the risks associated with making a flap, the possibility of creating glares and halos, the risk of an inflammatory condition called diffuse lamellar keratitis, and that fact that not everyone is a candidate for LASIK.

While flap complications are rare, they can be potentially devastating and cause an eye to lose best-corrected vision. With the advent of new laser profiles, glare and halos have been minimized greatly. LASIK is not recommended for patients with thin corneas, keratoconus, or other corneal diseases. The procedure is also not indicated for patients with excessive myopia, hyperopia, or astigmatism beyond the approved parameters of the laser. LASIK is not recommended for patients with significant systemic medical illnesses that may severely affect healing. Severe dry eye syndrome is an important contraindication to performing LASIK. In addition, patients in certain occupations may be restricted from undergoing LASIK.

Either convention or wavefront-guided lasers may be used in PRK, LASEK, and LASIK procedures. Conventional LASIK imprints the patient's manifest refraction onto the patient's cornea. Wavefront-guided lasers also correct aberrations not corrected by glasses, contacts, or conventional laser. Approximately 95% of low to moderate myopes achieve 20/20 with wavefront, which also has less incidence of glare and halos.

## LASIK: ADVANTAGES AND DISADVANTAGES

- Advantages
  - Little discomfort
  - Fast visual recovery
  - Long-term stability
- Disadvantages
  - Thin corneas not good candidates
  - Flap complications
  - Glare/halos
  - Diffuse lamellar keratitis (DLK)

## LASER DIFFERENCES

- Conventional laser
  - Laser program “imprints” standard refraction onto cornea
- Wavefront-guided or “custom” laser
  - “Imprints” patient's custom refraction
  - Theoretically removes aberrations in cornea
  - Higher chance of reaching refractive goal in low/moderate myopes
- Either can be used for PRK/LASEK/LASIK

SLIDE

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LASIK flaps can be lifted for retreatment many months after surgery. Enhancements are possible with both PRK and LASIK if the targeted refraction is not achieved. Targets can be set to give patients near, intermediate, or far vision in either eye. Careful attention must be used to explain the ramifications of each visual outcome so that the patient is not surprised and disappointed after surgery.

Refractive Procedures

## LASIK: OTHER ISSUES

- Enhancement
  - LASIK flaps can be lifted for later retreatment/refinement of refraction
- Monovision
  - Dominant eye set for distance
  - Other eye for intermediate or near
  - Careful explanation of visual outcome necessary for patient satisfaction

## Conductive Keratoplasty (CK)

SLIDE

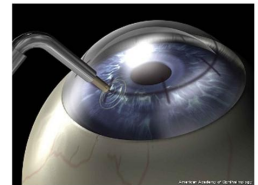
42

This technique uses a fine conducting needle to deliver radiofrequency energy into the peripheral cornea in set patterns. This shrinks corneal collagen fibers, thereby reshaping the cornea. CK can be used in low hyperopes or in presbyopes in order to sharpen near vision. The latter technique helps to reduce a presbyope's dependence on reading glasses by creating monovision.

Refractive Procedures

## CONDUCTIVE KERATOPLASTY

- Fine conducting needle delivers radiofrequency energy into peripheral cornea
- Locally shrinks collagen fibers
- Corrects low hyperopia/astigmatism
- Induces myopia to give presbyopes greater focus at near



## Intraocular Surgery

SLIDE

43

Conductive keratoplasty is a relatively safe procedure for a select group of patients. However, no long-term data exist to demonstrate stability over time.

Refractive Procedures

## CONDUCTIVE KERATOPLASTY: ADVANTAGES AND DISADVANTAGES

- Advantage
  - Relatively safe, quick, and noninvasive
- Disadvantage
  - No long-term data demonstrating stability

SLIDE

44

The advances in technology and techniques in intraocular surgery have greatly minimized risks of major complications. This safety profile makes intraocular surgery a relatively safe alternative to corneal-based procedures.

SLIDE

45

A phakic IOL is an artificial lens that is surgically implanted in the eye while leaving the eye's natural lens in place. This enables retention of natural focusing (accommodation) and helps to correct a refractive error. The cornea is not reshaped. Phakic IOLs are used to treat nearsightedness and farsightedness. They are typically used in younger patients with very high levels of correction. Because the implant can be removed, the procedure is reversible. The phakic IOL is associated with a small risk of cataract, iritis, and infection.

SLIDE

46

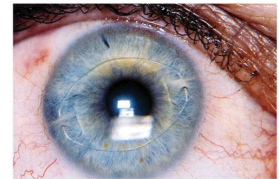
In natural lens replacement, an artificial lens is implanted in the eye, replacing the eye's natural lens. The cornea is not reshaped. It is used to treat nearsightedness and farsightedness; some IOL models can help with the inability to focus at near with age (presbyopia). Natural lens replacement can provide a refractive alternative for patients who are not candidates for other types of procedures.

## INTRAOCULAR SURGERY

- Improved technology and techniques allow for relatively safe “elective” intraocular surgery
  - Phakic IOL
  - Clear lens extraction
  - Accommodative IOL

## PHAKIC INTRAOCULAR LENSES (IOLs)

- IOL inserted into eye with natural lens still in place
- Allows for accommodation
- Typically used in younger high myopes
- Avoids ablation of cornea
- Removable
- Small risk of cataract and iritis



Phakic IOL in place

## NATURAL LENS REPLACEMENT

- Replacing noncataractous crystalline lens with IOL for refractive purpose
- Indications
  - Not a good photoablative candidate
  - Cornea too thin, too flat, too steep
  - High myopia/hyperopia

SLIDE  
**47**

Employing a common and well-understood process used in cataract surgery, natural lens replacement can correct high degrees of myopia and hyperopia and avoids the risks of corneal surgery but carries with it the risk of intraocular surgery, including endophthalmitis, hemorrhage, and retinal detachment. Patient expectations need to be firmly and clearly managed.

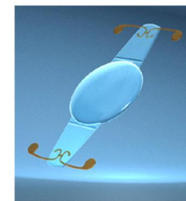
SLIDE  
**48**

New advances are being made in designing intraocular lenses that can provide focus both at near and at distance. One type of accommodative IOL vaults forward with movement of the ciliary muscle, mimicking accommodation (left). A multifocal IOL has several rings of different powers built into the lens, giving patients a pseudo-accommodation (right). The IOL focuses light for near, intermediate, and far vision at the same time. The retina and brain filter which image the patient intends to see. However, patients commonly report the effect of halos around lights.

### NATURAL LENS REPLACEMENT: ADVANTAGES AND DISADVANTAGES

- Advantages
  - Same procedure as cataract surgery
  - Avoids risks of flap creation and corneal ablation
  - Corrects high degree of myopia/hyperopia
- Disadvantages
  - Risk of intraocular surgery
    - Endophthalmitis, hemorrhage, retinal detachment
  - Patient expectations

### IOLs USED IN REFRACTIVE PROCEDURES



Accommodative IOL



Multifocal IOL

## THE FUTURE OF REFRACTIVE SURGERY

SLIDE  
**49**

The future of refractive surgery is extremely dynamic. Many new technologies are in trials today, and current lasers are undergoing improvement. Some promising technologies include customized intraocular lenses programmable in situ by light, and safer intraocular surgery instruments that require smaller incisions. Refractive surgery has the potential to improve the quality of life for our patients. A knowledge of refractive surgery options will help primary care providers counsel and advise their patients who are considering these procedures.

### REFRACTIVE SURGERY: THE FUTURE

- Ongoing improvement in current lasers and techniques
- Customizable intraocular lenses
  - Programmable in-situ with certain wavelengths of light
  - Smaller incisions and instruments improving safety profile
- Knowledgeable PCPs can help counsel and advise patients considering refractive procedures



# APPENDIX 1

## Resources

*Advances in Refractive Surgery* (PowerPoint presentations). San Francisco: American Academy of Ophthalmology; 2005.

Basic and Clinical Science Course, Section 8: *External Disease and Cornea*. San Francisco: American Academy of Ophthalmology; (updated annually).

Basic and Clinical Science Course, Section 11: *Lens and Cataract*. San Francisco: American Academy of Ophthalmology; (updated annually).

Basic and Clinical Science Course, Section 14: *Refractive Surgery*. San Francisco: American Academy of Ophthalmology; (updated annually).

Bradford, Cynthia A, ed: *Basic Ophthalmology for Medical Students and Primary Care Residents*. 8th ed. San Francisco: American Academy of Ophthalmology; 2004.

*Refractive Errors* (Preferred Practice Pattern). San Francisco: American Academy of Ophthalmology; 2002.

*Understanding Refractive Surgery Patient Education DVD*. San Francisco: American Academy of Ophthalmology; 2003.