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
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
Primary care physicians’ understanding of refractive procedures helps ensure quality patient care.
Refractive Errors

The human eye
REFRACTIVE ERRORS

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

- Success relies on sound total eye health
- Ameliorate correctable ocular disorders prior to surgery
DISORDERS OF TEAR FILM AFFECTING REFRACTION

• Dry eye
  – Watery or dry eyes, visual fluctuation

• Blepharitis (shown)
  – Burning, watering
CORNEAL DISORDERS AFFECTING ACUITY: KERATOCONUS
CORNEAL DISORDERS AFFECTING ACUITY:
CORNEAL SCARRING

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)
LENS DISORDERS AFFECTING ACUITY

Cataract seen through pupil as a white opacity
RETINAL DISORDERS AFFECTING ACUITY

- Diabetic retinopathy
- Retinal detachment
- Cystoid macular edema
- Retinal scar
- Age-related macular degeneration
CNS DISORDERS AFFECTING ACUITY

- Amblyopia
- Disorders of visual cortex
- Ischemia
PATIENT EVALUATION FOR REFRACTIVE PROCEDURE

- Comprehensive process requiring excellent doctor-patient communication
  - Preoperative interview
  - Examination
  - Ancillary testing
PREOPERATIVE EXAMINATION: PATIENT EXPECTATIONS

• Possibly most important predictor of surgical “success”
• Patients demanding “perfect vision” not good candidates
PREOPERATIVE EXAMINATION: SOCIAL HISTORY

- Visual needs of work or play: Needs of a teacher versus a young baseball player versus a middle-aged golfter/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?
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)
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
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
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
RADIAL KERATOTOMY (RK): COMPLICATIONS

• Lack of stability—refractive fluctuations and shifts

• Complications
  – Irregular astigmatism
  – Glare
  – Wound dehiscence
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
PHOTOABLATIVE PROCEDURES

- Excimer ("excited dimer") laser
  - Allows precise removal of corneal tissue
  - Pattern can be "customized"
- Used for PRK, LASEK, LASIK
PHOTOREFRACTIVE KERATECTOMY (PRK): PROCEDURE

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

- 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
CONDUCTIVE KERATOPLASTY: ADVANTAGES AND DISADVANTAGES

- Advantage
  - Relatively safe, quick, and noninvasive

- Disadvantage
  - No long-term data demonstrating stability
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
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
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