Refractive Surgery

An Intro to the Basics of Screening and Post Operative Care

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LASER VISION CORRECTION

What is Refractive Surgery?

Vision correction surgery performed by changing the refractive (light bending) properties of the eye

Not cosmetic but functional because it restores a person's ability to visually function without external aids

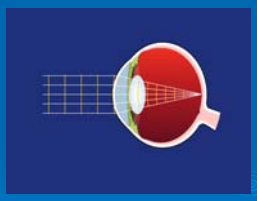
LASER VISION CORRECTION

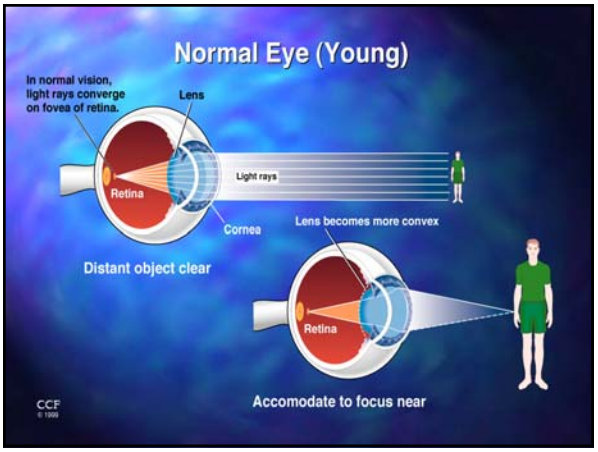
How The Eye Works

Cornea and lens focus image on the retina

Near objects require stronger focusing than distant targets

Laser surgery reshapes the cornea and changes its focusing power





LASER VISION CORRECTION

Nearsighted (Myopia)

Focusing power of the eye is too strong

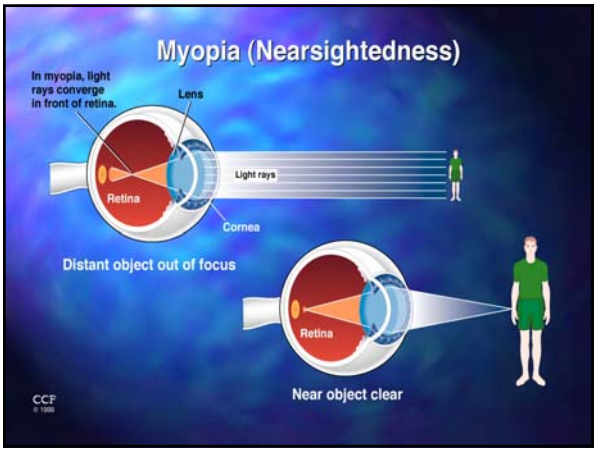
Close objects appear clear, while distant objects appear blurred

Caused by an eyeball that is too long

Myopia increases in childhood and adolescent years with eye elongation

Affects 25% of the population

Refractive Solution: Decrease the central power of the cornea



LASER VISION CORRECTION

Farsightedness (Hyperopia)

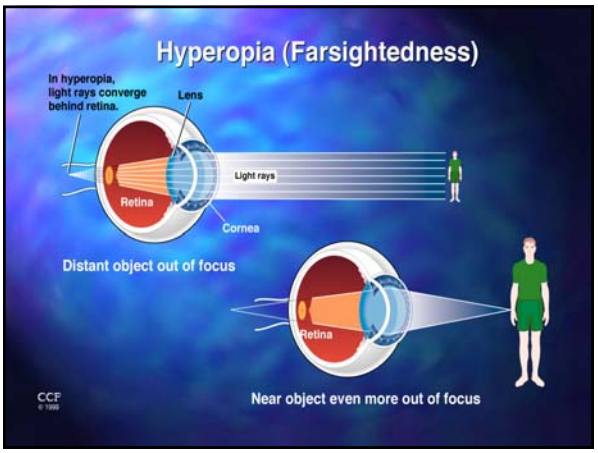
Focusing power of the eye is too weak (opposite of nearsightedness)

Distance vision is clearer than near vision, but both are blurry

Often affect vision only later in life (30's to 40's)

Caused by an eyeball that is too short

Refractive Solution: Increase the central power of the cornea



LASER VISION CORRECTION

Astigmatism

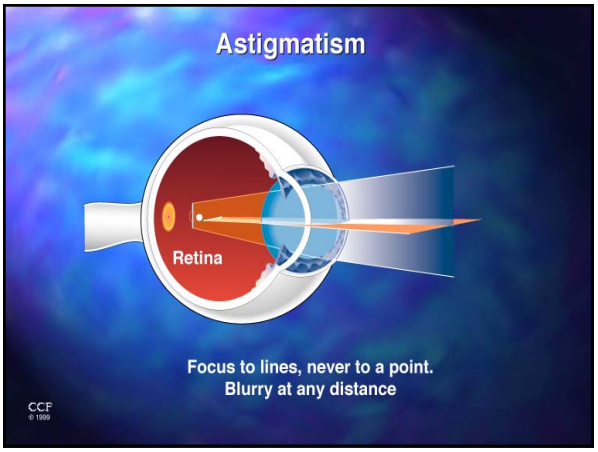
Focusing power of the eye is not uniform

Caused by uneven curvature of the cornea (football shaped)

Blurry vision at all distances

May cause distorted or double vision

Refractive Solution: Flatten the steep meridian, and steepen the flat meridian



LASER VISION CORRECTION

Presbyopia

Need reading or bifocal glasses to see up close

Caused by natural aging process of the eye

The lens inside the eye becomes inflexible

Begins at approximately 45 years of age

LASER VISION CORRECTION

Vision Correction in Presbyopes

Correct both eyes for distance - reading glasses

Monovision:

- Correct one eye for distance; one eye for near
- May need spectacles for near at some point
- Literaure review shows between 80 - 92.5% acceptance rate
- Gives most independence from glasses

Can consider multifocal lenses (intraocular surgery)

No good method to reverse presbyopia at the current time

LASER VISION CORRECTION

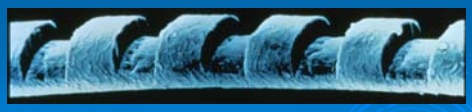
Laser (PRK & LASIK)

Laser beam removes a thin layer from cornea, changing its shape so light can focus on the retina

Typical laser treatment 5 - 60 seconds

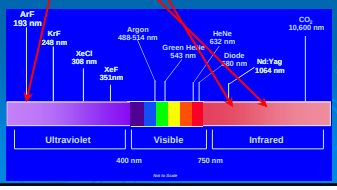
Most precise correction method so far

Results stable after initial healing

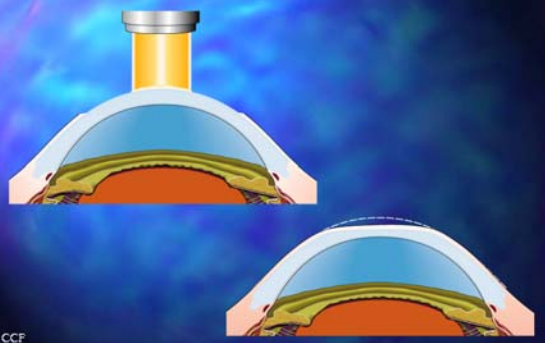


Lasers in Refractive Surgery

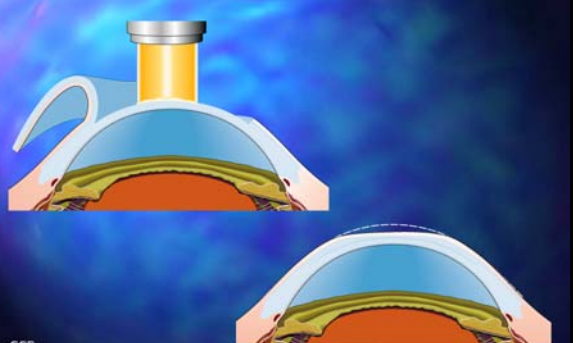
- Excimer Laser (LASIK, PRK) – 193 nm (UV wavelength)
  - Mechanism: Photo-ablation
- Femtosecond Laser (flaps) – 1057 nm (IR wavelength)
  - Mechanism: Photo-disruption (plasma mediated ablation)
- Holmium Laser (hyperopia) – 2100 nm (IR wavelength)
  - Mechanism: Photo-thermal-mechanical



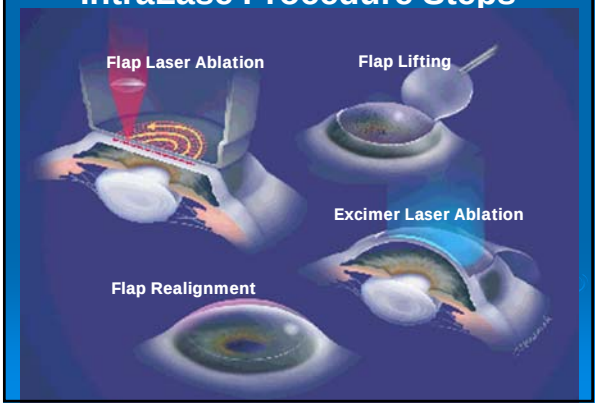
PRK (Photoreactive Keratectomy)



LASIK (Laser in-situ Keratomileusis)



IntraLase Procedure Steps



LASIK Video

Screening Candidates for Refractive Surgery

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Components of the Evaluation

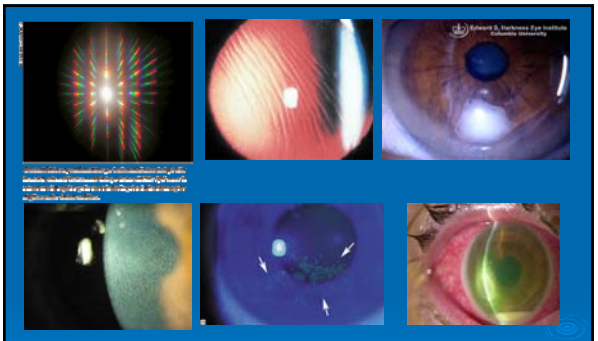
- Patient History
- Examination
- Ancillary Testing

Patient History

- Key aspects requiring evaluation:
  - Patient Expectations
  - Social History
  - Medical History
  - Pertinent Ocular History
  - Patient Age, Presbyopia, and Monovision

Patient Expectations

- Be cautious of very particular or quarrelsome patients
- Inappropriate expectations are the leading cause of dissatisfaction
- Make it clear refractive surgery does NOT improve BCVA
- Emphasize results are usually long lasting, but NOT permanent
  - Cataract, glaucoma, RD, presbyopia, myopic regression, AMD, corneal dystrophies, etc
- Beware of patients looking for guaranteed 20/20 UCVA or perfect distance and near acuity
- Explain unavoidable risks
  - glare/haloes, dry eye, period of visual fluctuation, possible need for enhancement, striae, epithelial ingrowth, DLK, etc.
- The more information the patient has beforehand, the easier it will be to deal with unexpected problems post-op



Social History

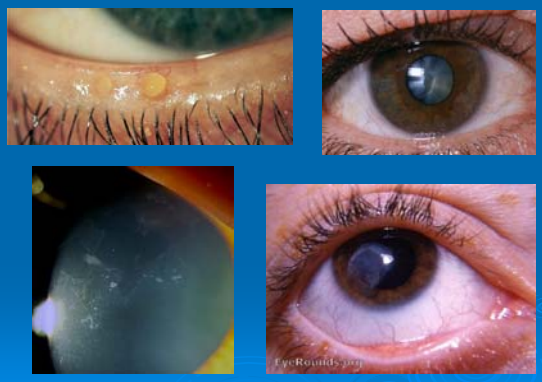
- Identify visual requirements of patient's profession/hobbies
  - Readers may want to be corrected for near or monovision
  - Military, police, etc may have requirement for no flap based procedures
  - A minimum UCVA may be required
- Identify potential risks of patient's profession/hobbies
  - Boxers, wrestlers, horseback riders have higher trauma risk
- Tobacco and alcohol use
  - Could affect healing time, increase risk of haze/scarring after surface ablation

Medical History

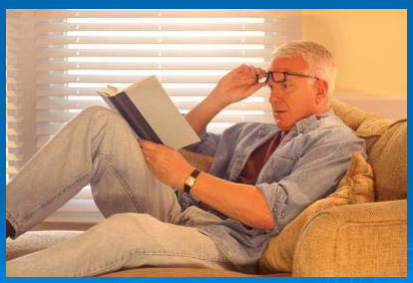
- Systemic conditions
  - Connective tissue disorders – poor healing
  - HIV/AIDS – increased infectious risk
  - Diabetes – poor healing, cataract risk
  - Pregnancy/Nursing – change in corneal hydration and refraction
    - Wait 3 months after delivery and cessation of nursing
- Prior surgeries/Trauma
  - Cataract surgery
    - Toric IOL, Multifocal lenses?
  - PKP
  - Prior refractive procedures
  - Pacemakers or defibrillators (manufacturers recommend against)
- Current/Prior medications
  - Corticosteroids, Chemotherapeutic agents – increased risk of infection, cataract, macular edema or retinopathy
  - Isotretinoin/Amiodarone – poor healing (no solid evidence in peer-reviewed literature), amiodarone can damage MGs and lead to dry eye
  - Sumatriptan/HRT/Anti-histamines – delayed epithelialization
  - Ocular medications

Pertinent Ocular History

- History of glasses/contact lens wear
  - Rigid or soft, daily or extended, wearing schedule, years worn, cleansing agents, reason for contact lenses over glasses
  - CL can change the shape of the cornea,
    - Need to be out of CL for 3 days to 2 weeks for soft
    - Out of RGP 2-4 weeks, 1 month for every decade of wear
    - Keep out of lenses until stable topography/refraction
- Stability of Current Refraction
  - 0.5D or less change in sphere/cyl over last year
- Dry Eye
- Blepharitis
- Recurrent Erosions
- Retinal Tears/Detachment
- Glaucoma
- ARMD/Retinopathies
- Amblyopia
- Strabismus
- Optic neuropathy
- Cataract



Patient Age, Presbyopia, Monovision



- Loss of near vision should be predicted and discussed based on age
- Discuss specific tasks that may be affected
  - Reading, shaving/makeup, computer reading, etc
- Patient MUST be willing to accept this reality before surgery
- Monovision discussion vs readers
  - Target: depends on visual requirements
    - Anywhere from -0.75 to -2.50,
    - Best tolerated/functional typically -1.50 to -1.75
    - Watch out for loss of depth perception, intolerable anisometropia
  - Could try contact lens trial, check muscle imbalance
  - Traditionally dominant for distance, reverse mono also well accepted by most
    - Dominance testing with bilateral viewing through aperture, and then closing eye

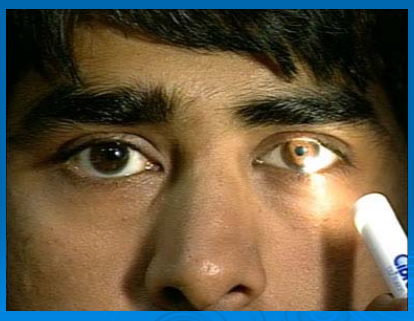
Examination

- Uncorrected Visual Acuity, Manifest/Cycloplegic Refraction
  - Measure UCVA, Glasses Rx and Acuity with Rx
  - MRx pushing plus (negate accomodation)
  - Best acuity attainable is the goal (beyond 20/20 if possible)
  - Automated refraction with autorefractor or abberometer helpful
  - Tropicamide or cyclopentolate 1% for CRx
    - Neutralize sphere (not cyl) from MRx
  - If difference between MRx and CRx high, likely MRx was overminused
  - Laser program can be with either MRx or CRx (depends on age, myopia vs hyperopia, visual requirements, etc)
    - Treating too much minus may push to hyperopia, tolerable in young but not older patients near presbyopia

Components of Examination

- Visual Acuity and Refraction
- Pupillary Examination
- Ocular Motility, Confrontation Fields, Ocular Anatomy
- Intraocular Pressure
- Slit Lamp Exam
- Fundus Exam

Pupillary Exam



- Pupil size in bright light and dim light
- Check for APD
- Techniques
  - Near card in dim light at distance
  - Light amplification pupillometer
  - Infrared pupillometer
- Large pupil size MAY be risk factor for glare/haloes
  - Pupil size greater than optical zone may increase risk due to greater HOAs
  - Size of effective optical zone and level of refractive error may be greater risk factor

Ocular Motility, Confrontation Fields, Ocular Anatomy

- Asymptomatic tropia or phoria may become manifest after surgery
  - Ex. Exotropia after accommodation from hyperopic Rx lost
- Trial of contact lenses may be helpful to predict post operative problems
- CVF should be assessed to determine if any glaucomatous or intracranial origins of VF loss
- Small palpebral fissures or large brows may pose problem for flap creation in LASIK

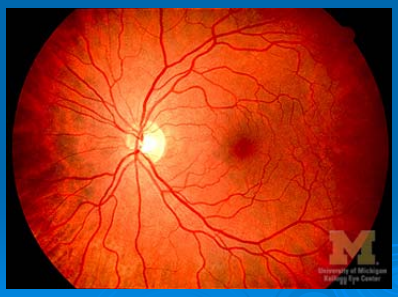
Intraocular Pressure

- Should be checked after the MRx and topography
- Glaucoma patients should be warned of high pressures with suction in LASIK
- Topical corticosteroids post op could increase IOP
- Implications for IOP checks in glaucoma
  - Thinner corneas yield falsely low Ga IOP

Slit Lamp Examination

- Eyelids
  - Check for blepharitis/meibomitis, tear lake
- Conjunctiva
  - Check for scarring, chalasis
- Cornea
  - Check for signs of keratoconus: thinning, steepening
    - Contraindication to surgery
  - Surface anomalies: decreased TFBUT, PEE, ABMD
    - Dry eye needs pre op treatment if significant
  - Endothelial anomalies
    - Edema generally a contraindication for refractive surgery
  - Stromal and Bowman's Membrane Dystrophies
    - Granular and Avellino can lead to interface opacities post LASIK
    - Reis Buckler and Thiel Benke dystrophy can lead to severe surface scarring after PRK
- Anterior Chamber, Iris, Lens
  - Shallow chamber is contraindication to certain phakic IOLs
  - Cataracts are a relative contraindication, should mention that IOL power calculations less predictable post LASIK
  - Cataract extraction, with/without toric or multifocal options, could be better options
  - Good idea to give patients their records of preoperative refractions and keratometry , amount of laser ablation performed, and post op refraction***

Dilated Fundus Examination



- Optic nerve assessment
  - Optic nerve drusen, glaucoma, pallor
- Peripheral retina
  - Peripheral breaks
- Macula
  - Maculopathies, retinal edema

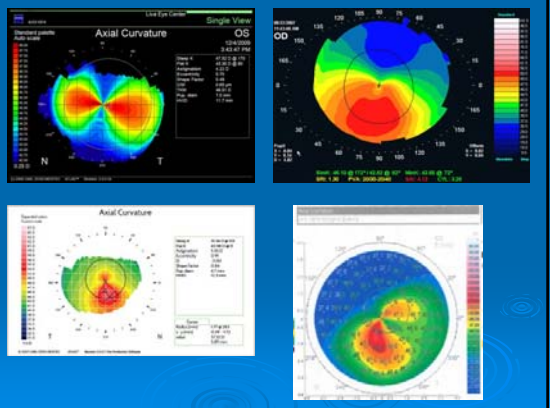
Ancillary Tests

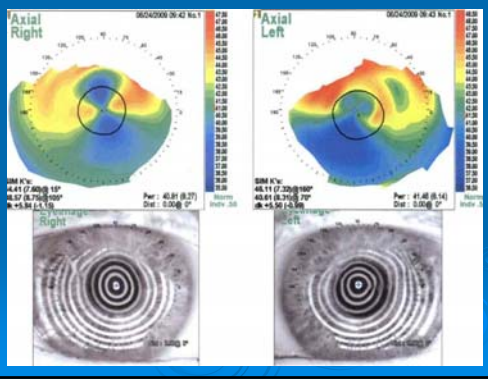
Ancillary Tests

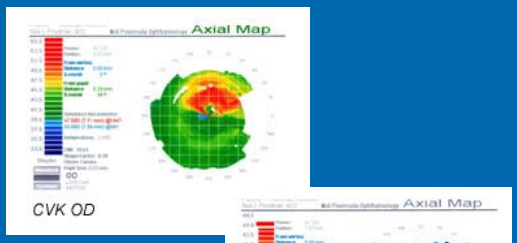
- Corneal topography
- Pachymetry
- Wavefront Analysis
- Calculation of residual stromal bed thickness

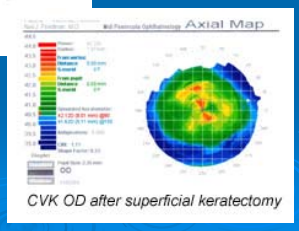
Corneal Topography

- Critical test, mandatory for screening
- Methods of testing include:
  - Placido disk
  - Scanning slit beam
  - Rotating scheimpflug photography
  - High frequency ultrasound
  - Ocular coherence tomography
- Provide color maps of corneal power and elevation, overall evaluation of curvature
- Candidates have spherical corneas or symmetric astigmatism
- Causes of irregular astigmatism include:
  - Keratoconus, Pellucid marginal degeneration
  - Contact lens induced warpage
  - Corneal scarring
  - Dry eye
  - ABMD



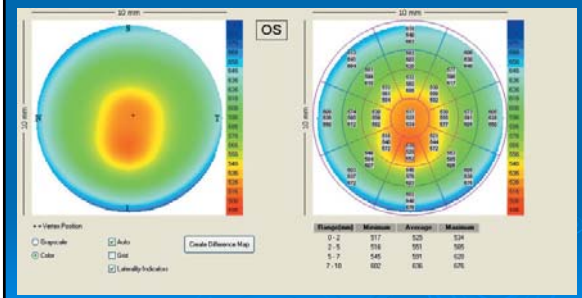




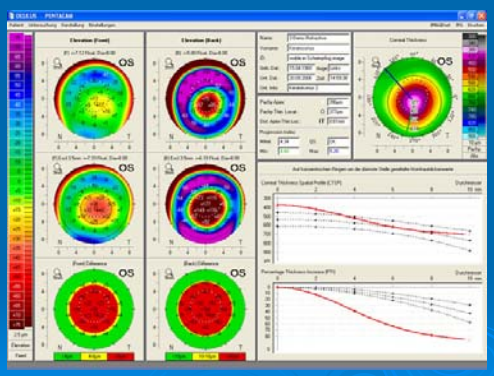


- Unusually steep of flat corneas can risk poor flap creation with microkeratome
  - Flatter than 40.0D – small flap or free caps
  - Steeper than 48.0D – button hole flaps
- Excessive flattening or steepening after ablation can lead to poor visual quality
  - Flatter than 34.0D, steeper than 50.0D
- To predict post op keratometry values
  - Subtract 80% of refractive correction from average pre-op K readings with myopic correction
  - Subtract 100% of refractive correction from average pre-op K readings with hyperopic correction
- Refraction should be rechecked if axis of corneal astigmatism very different from refractive astigmatism
  - Factors: lenticular astigmatism, posterior corneal curvature, dry eye
  - Most surgeons treat the amount and axis of refractive astigmatism

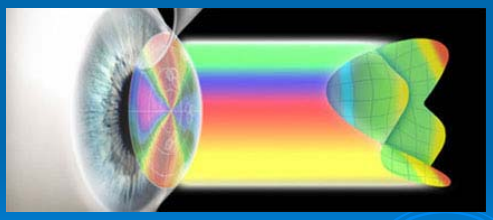
Pachymetry



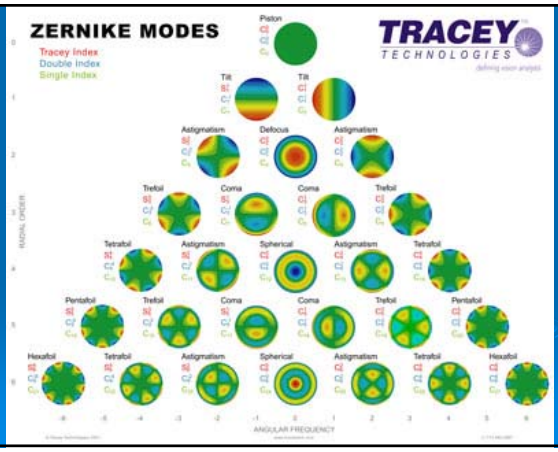
- Usually by ultrasound pachymetry, though tomographic systems also very accurate
- Pachymetry maps can also be used as a screening tool
  - Belin Ambrosio profile on Pentacam
  - Algorithms judging relative pachymetry differential
- Central measurement is the key
- Be very suspicious of corneas less than 490-500um thickness (2 SD below normal thickness)
- Residual stromal bed thickness should be between 250-300um
  - Corneal thickness – flap thickness – ablation depth
  - Based on *intended* amount of correction, **not** nomogram entry
  - Between 12-20um per D correction (laser and optical zone dependent)
- If treatment predicts close to 250um residual stromal bed thickness, enhancement may not be safe
- PRK may be safer in borderline RSBT cases



Wavefront Analysis



- Information can be used for “guided” ablations
- Information can give preoperative or postoperative higher order aberrations
- Can give objective refraction measurements
- If MRx and wavefront refractions are not similar, patient needs rerefraction and may not be candidate for “guided” treatment
- Typically more tissue removed than in “standard” treatments



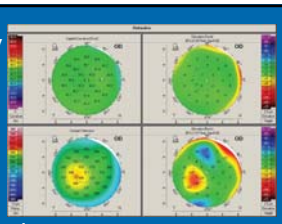
Correction Limits for Refractive Surgery

- LASIK
  - Between -10.00 to +4.00, 4D cyl for most lasers
- PRK
  - Between -10.00 to +4.00, 4D cyl for most lasers
- ICRS
  - Between -1.00 to -3.00, no cyl correction
- Phakic IOL
  - Between -3.00 to -20.00D, no cyl correction (with current FDA approved lenses)
- Refractive lens exchange
  - All ranges, but cyl correction only up to 4.11D at corneal plane for current FDA approved lenses

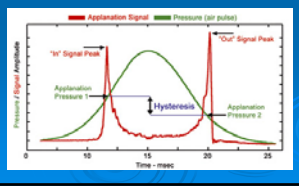
Discussion of Findings and Informed Consent

- Risk of:
  - Decreased BCVA
  - Glare/haloes
  - Dry Eye
  - Change in vision quality
  - Flap displacement, DLK, ingrowth, striae
  - Incomplete, decentered, or buttonhole flap
  - Decentered ablation
  - Need for possible enhancement
  - Infection

- Corneal tomography



- Ocular Response Analyzer



Post-operative Complications and Management in Refractive Surgery

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Post Operative Management

- Typically involves a combination of:
  - 4th or 5th generation quinolone for 1 week
  - Steroids for 1 week with LASIK
  - Tapering regimen of steroids for PRK
  - Non steroidal ophthalmic medication in some instances
- Contact lens placement for 1 week in the case of PRK to help hasten healing
- Pain management for PRK, along with vitamin C supplementation
- Shield/glasses to protect eyes
- Lubricating drops for post refractive dry eye

Post Operative Management

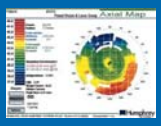
- Follow up visits at 1 day, 1 week, 1 month, 3 months, 6 months
- Full refractive correction is typically considered stable by 3 months in LASIK, 6 month with PRK
  - Any enhancement must wait for refractive stability
- Typically at each visit starting 1 week post op, vision and MRx obtained along with staining and topography (once contact is out with PRK)
  - If complaining of glare despite good acuity, may also need abberometry
- Gentle pressure check can be attempted between 1-4 weeks after surgery

Complications Common to Both LASIK and PRK

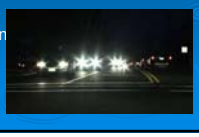
- Overcorrection
  - Overcorrection happens in older people in general due to decreased hydration and slower healing
    - Beware of excessive stromal dehydration or hydration during the procedure
    - Humidity and temperature controlled room is important
- Undercorrection
  - Occurs more commonly at higher degrees of correction due to greater severity of regression
  - May partially respond to steroid treatment
  - Regression and haze after PRK makes reccurrence after retreatment more likely, and MMC may need to be used
- Enhancement rates typically 1% per D spherical correction, 10% per D of astigmatic correction

Complications Common to Both LASIK and PRK

- Central islands
  - Area of central steepening on topography surrounded by area of flattening
  - Steepening of 1D in >1mm area
  - Results in poor visual quality
  - More common with older lasers

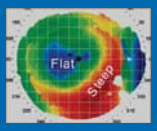


- Optical aberrations
  - Glares, halos, etc especially at night
  - Most prevalent with smaller ablation zones and higher order of treatment
  - Exacerbated in dim lighting
  - HOAs evaluated with wavefront mappin
  - ? Correlation with pupil size



Complications Common to Both LASIK and PRK

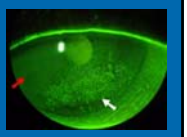
- Decentered ablation
  - Critical for accurate outcome, especially in hyperopic treatments
  - Centration is better in a non-miotic pupil
  - Eye needs to be perpendicular to treatment
  - Can lead to optical aberrations and decreased acuity
  - Watch out for positive angle kappa



- Corticosteroid induced complications
  - Increased IOP
  - Associated mostly with prolonged topical steroid use
    - Surface ablation typically associated with steroid use anywhere from 1-4 months
    - Diffuse lamellar keratitis can be a reason for prolonged use in LASIK

Complications Common to Both LASIK and PRK

- Dry Eye and Corneal Sensation
  - Reported in 60-70% of patients in varying degrees
  - Resolved in around 6 months with surface ablation, but may take longer in LASIK
  - Treatment with non-preserved tears and ointments, plugs, etc



- Infectious keratitis
  - Most common agents are staph aureus, MRSA, S. pneumoniae, and S. viridans
    - More commonly early onset
  - Atypical mycobacteria, and fungi also reported
    - Typically late onset after weeks
  - Post-LASIK interface keratitis may require flap lift and stromal scrape for culture and irrigation

Advantages of PRK

- Preservation of corneal stromal tissue means less potential for weakening and ectasia
- Decreased depth of treatment preserves corneal nerves, may diminish the duration of post op dry eye
- Lack of LASIK flap means complications such as flap striae, epithelial ingrowth, and diffuse lamellar keratitis are avoided
- Procedure takes less time in general and does not require the use of expensive equipment for flap creation

Disadvantage of PRK

- Extended healing time
  - Takes about 3-4 days to re-epithelialize beneath bandage lens, and during this time some pain is common
  - Functional vision may take up to a week to obtain due to epithelial hypertrophy and remodeling
- Delayed refractive stability
  - Myopic and hyperopic treatments can show mild regression during the first 6 months
    - More common with higher degrees of treatment
  - Enhancements must be delayed 3 months longer than LASIK to ensure refractive stability
- Risk of early post operative keratitis
  - Epithelial defect, bandage lens, and steroids are key risk factors

Disadvantage of PRK

- Risk of persistent epithelial defect
  - Patients with dry eye, connective tissue disease, DM2, smokers at high risk
  - Increases the risk of corneal haze, irregular astigmatism, refractive instability, prolonged visual recovery, and infection
  - NSAIDs discontinued, decrease preserved drops
- Sterile Infiltrates
  - Associated with use of bandage contact lenses
  - Secondary to immune reaction
  - Treated with steroids, discontinuation of NSAIDs

Corneal Haze

- Unique complication of surface ablation
- Develops typically several weeks post ablation with peak intensity at 1-2 months
- Gradually diminishes following 6-12 months
- Late haze may occur even a year after documented clear corneal, but very rare
- Occurs as a result of abnormal epithelial-stromal wound healing and deposition of abnormal collagen from activated stromal keratocytes

Corneal Haze

- Associated with greater amounts of correction and smaller ablation zones
- Ultraviolet light (UVB) may play a critical role in prolonging the stromal healing process, leading to haze
- UV blocking glasses and hats for 1 year are recommended
- Prolonged steroids may be beneficial, particularly in patients with haze and undercorrection
- Haze can be addressed surgically with superficial keratectomy or PTK coupled with MMC 0.02%
- Reablation should be delayed at least 6-12 months to allow for clearance of haze

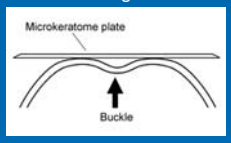
LASIK Complications

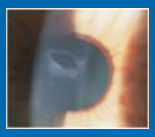
- Buttonhole flaps
- Free flaps
- Epithelial Defects
- Corneal Perforation
- LASIK flap tear
- Microstriae/Macrostriae
- Flap dislocation
- Diffuse lamellar keratitis
- Infectious lamellar keratitis
- Epithelial ingrowth
- Interface Debris
- Post refractive ectasia

Buttonhole flaps

Buttonhole flaps

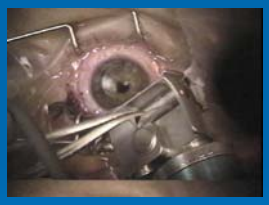
- Incidence less than 0.25%
- Due to either excessive corneal steepness or loss of suction during microkeratome pass





- Leave the flap as it is, place a BCL, and do not lift!
  - Irregular astigmatism and scarring will be exacerbated if ablation is performed
- Wait 3 months to stabilize, then perform PRK (LASIK at your risk!)

Free cap



Free cap

- Incidence less than 0.25%
- Generally due to very flat corneas <41D, small diameter corneas, or inadequate suction leading to a thinner-than-intended flap
- KEY: Check the microkeratome head before the assistant takes it away.
- Store the cap epithelial side down on a drop of BSS in a sterile container
- If the stromal bed is smooth and the cap of normal thickness, proceed with ablation
- Align cap in the proper orientation based on preoperative ink marking +/- 10-0 nylon suture with a contact lens

Epithelial Defect

Epithelial Defect

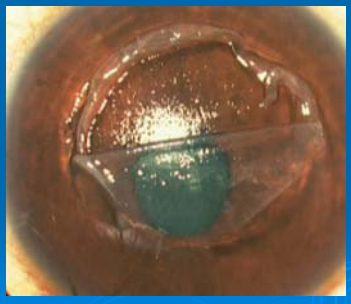
- The most common flap complication with microkeratomes
- Higher risk with older age
- Prevention is key:
  - Screen for ABMD – better to have PRK
  - Avoid epithelial toxicity from anesthetics
  - Prevent excessive epithelial drying
  - Lubrication prior to the microkeratome pass
  - Avoid maintaining suction on reverse pass
- After it occurs:
  - Proceed with ablation
  - Check the margins carefully for implanted epithelium prior to flap replacement
  - Place a BCL
  - If defect is large, abandon second eye
  - Broad spectrum antibiotics and intense application of steroids to prevent diffuse lamellar keratitis
  - Daily follow up

Corneal Perforation

Corneal Perforation

- Most feared and rare complication
- Given high pressures above 100mmHg during injury, expulsive hemorrhage is possible
- Occurred mostly with older microkeratome models that did not have preassembled depth plates
- Also associated with LASIK performed in very thin corneas
- Less drastic consequences typically when perforation occurs during ablation
- Preserve as much tissue as possible
- Have needle driver and suture on hand
- Refer for emergent surgery!

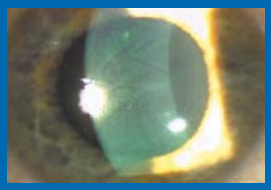
LASIK flap tear



LASIK flap tear

- Rare complication of flap lift
- May be more common with thinner flaps, femtosecond flaps, and with increased duration of time from initial procedure
- May be more common in larger diameter flaps as stronger healing occurs proximal to the limbus
- If unsure of mechanical stability, PRK enhancement may be safer option
- Prevention with meticulous technique, gentle flap dissection (avoid pulling up), and knowing when to quit!

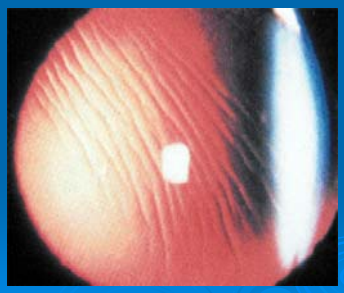
LASIK flap microstriae

Microstriae

- Superficial folds believed mostly to be in Bowman's layer
- Thought to be from flap mismatch with stromal bed or flap contraction (tenting effect)
- Appear as fine, hair-like irregularities best seen in retro-illumination, though fluoroscein staining may help in visualization (negative pattern)
- Generally are only minimally visually significant and do not appear well on topographic color maps
- Optical aberrations may resolve with time as epithelium fills in the valleys to restore tear distribution
- Aberrometry may provide some benefit in the analysis of visual significance
- Treatment paradigm is broad:
  - PFAT with BCL
  - De-epithelialization with stromal hydration using hypotonic solution
  - Flap lift with irrigation of interface and flap stretching in perpendicular direction
  - Various tools:
    - Rhein's Johnston Applanator, Tress Kornmehl Press, the Pineda LASIK Iron, Acorn's Donnenfeld Striae Removal Spatula, Herzig Compressor
  - Flap suturing with multiple interrupted sutures
  - Trans-epithelial PTK

Macrostriae



Macrostriae

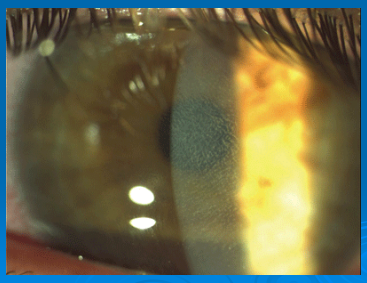
- Represent full thickness folds involving flap stroma
- Occur with initial malposition or with flap slippage
- Risk factors include over-irrigation of interface, flap edema, or trauma
- Incidence is close to 1% in most retrospective studies
- Prompt diagnosis and treatment is mandatory!!
- If not addressed well within first week, epithelial molding can fixate folds
- Treatment
  - Flap lift with interface irrigation and perpendicular stretching
  - +/- epithelial debridement overlying the flap
  - Placement of BCL
- Fixed folds not amenable to the above can be treated with flap suturing

LASIK flap dislocation

Flap dislocation

- Commonly occurs during the first 24 hours after LASIK before epithelium seals the gutter and flap scarring has occurred at the edge
- Very blurry vision and often painful
- Epithelium can sometimes be noted growing onto the stromal bed
- Urgent treatment is mandatory
  - Flap unrolled and smoothed out
  - Thorough debridement of stromal bed and stromal portion of flap
  - Flap allowed to adhere to bed for 5 minutes, followed by smoothing
  - Placement of BCL
- Femtosecond flaps tend to heal stronger and could be more protective against late dislocation

Diffuse Lamellar Keratitis

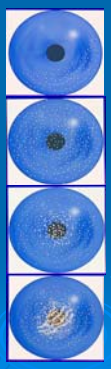


Diffuse Lamellar Keratitis

- "Sands of Sahara"
- Sterile inflammation within LASIK flap interface precipitated by any cause of anterior stromal inflammation
  - Epithelial defect
  - Infection
  - Meibomian Gland Secretions
  - Iodine
  - Interface foreign body
  - High levels of energy during creation of the flap
- Can range from asymptomatic to marked reduction in acuity
- Typically begins in flap periphery and extends centrally into visual axis

Diffuse Lamellar Keratitis

- Grade 1
  - Focal granular material 1-7 days after LASIK
  - No ocular inflammation
  - Normal acuity
  - Treatment: intensive topical steroids every hour
  - Progsnosis: excellent
- Grade 2
  - Diffuse granular material 1-7 days after LASIK
  - No ocular inflammation
  - Normal acuity
  - Treatment: intensive topical steroids every hour +/- flap lift with irrigation
  - Progsnosis: excellent after several weeks
- Grade 3
  - Diffuse confluent material 1-7 days after LASIK
  - Injection, no intraocular inflammation
  - Reduced acuity
  - Treatment: intensive topical steroids every hour with flap lift and irrigation, repeat if necessary in 1-2 days with antibiotics
  - Progsnosis: excellent after several weeks
- Grade 4
  - Dense, confluent material 1-7 days after LASIK Intense inflammation 2-4mm centrally
  - Injection, no intraocular inflammation
  - Markedely reduced acuity
  - Treatment: intensive topical steroids every hour Flap lift with irrigation and wiping with sponge Steroids and antibiotic
  - Progsnosis: decreased acuity from irregular astigmatism, hyperopia, stromal thinning, and striae



Infectious Lamellar Keratitis

- Thankfully rare (0-1.5%)
- Typically associated with pain and decreased vision, redness, photophobia
- Typically begins 2-3 days post op and is more focal than DLK
- Not typically confined to interface or flap borders
- May involve an AC reaction
- Severe irregular astigmatism, corneal scarring, and flap melt may result
- Most common infectious organisms are gram + (within 10 days), then atypical mycobacteria (usually occur after few weeks)
- More rarely fungal or viral (laser may precipitate reactivation of herpetic disease)
- Treatment
  - Flap lift, culture/biopsy of infiltrate, debridement of stromal bed and flap stroma, irrigation with antibiotics

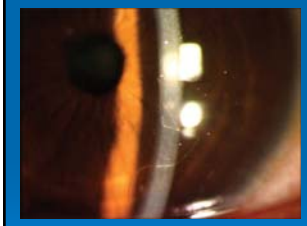
Epithelial Ingrowth

Epithelial Ingrowth

- Growth of epithelium within interface either from the flap edge or from implanted epithelium during flap manipulation
- More commonly occurs with ABMD, patients of older age, epithelial defects, after multiple enhancements, or with misalignment of flap edge
- Peripheral 1-2mm usually inconsequential
- Pattern of growth includes nests, strands, pearls, or sheets
- Growth into axis can generate some irregular astigmatism
- Rarely, nutritional deprivation of flap stroma can precipitate melt
- Treatment in progressive or symptomatic cases requires flap lift, scraping of stromal bed as well as flap stroma
- Flap suturing or gluing may be employed in recurrent cases, particularly if a melt has occurred at the edge

Keratolysis after epithelial ingrowth

Interface Debris



Interface debris

- Commonly seen
- Origins include lint from clothing, metal particles from surgical instruments, blood from limbal bleeding, and meibomian secretions
- Generally well tolerated and not visually significant
- Materials that generate significant inflammatory reactions, ie dense blood or large fibers, need to be removed via flap lift to prevent DLK
- Fibers noted at the flap edge which could provide a path for epithelial ingrowth need to be removed immediately
- Prevention is key:
  - Proper draping of lids and lashes
  - Decreased surgical time
  - Adequate interface irrigation prior to flap alignment
  - Sterile/clean operating suite

Postoperative Keratectasia

Postoperative Keratectasia

- Presents 1-12 months after refractive surgery
- Screening patients properly is key!
  - Normal topography with regular astigmatism
  - Residual stromal bed >250um (300um is more common threshold)
    - Munnerlyn equation: [diopters corrected x (optical zone)^2] / 3
    - Usually around 15um per diopter of correction
      - Factors influencing: zone, laser, stromal hydration, amount of correction
  - Pre operative corneal thickness of at least 500um
  - Stable refractions without increasing degrees of astigmatism in young patients
  - Unproven but potentially useful screening tools include: elevation maps, wavefront analysis, pachymetric profiles, ocular response analyzer
- No specific test is diagnostic of predisposition towards ectasia
- LASIK may simply accelerate a natural tendency towards ectasia
- Risk factors for ectasia after LASIK may not necessarily predict ectasia with PRK
- Measure flap thickness and residual stromal bed thickness intraoperatively to ascertain safety
- Treatment is with RGP lenses, CXL, or corneal transplantation

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