REFRACTIVE SURGERY:
It's Not Just LASIK Anymore

Paul C Mitchell OD FAAO
Eye Care of Delaware
Newark, DE

So you think LASIK is always the best option for refractive surgery?

What Are The Options?
- Corneal Refractive Surgery
  - LASIK
  - CustomVue LASIK
  - PRK
  - CustomVue PRK
  - Epilex
  - LASEK
  - Astigmatic Keratotomy (AK)
  - Limbal Relaxing Incisions (LRI)
  - Radial Keratotomy (RK)
  - Small Incision Lenticule Extraction (SMILE)
- Refractive Lens Exchange (RLE)
  - Multifocal IOL
  - Toric IOL
  - Femtosecond Laser
  - Extended Range IOL
  - Phakic IOL
  - ICL
  - Verisyse
  - KAMRA
  - Intacs
  - Conductive Keratoplasty (CK)

What Dictates Which Procedure?

Their Refractive Error
- Myopia
  - Low
  - Medium
  - High
- Hyperopia
  - Low
  - Medium
  - High
- Astigmatism

Patient’s Goals
- Good Distance Vision
- Good Near Vision
- Both Distance and Near Vision
Age

- Pre-presbyopic
- Presbyopic
- Beginning cataract?

Corneal Findings

- Cornea too thin for LASIK
- Irregular corneal topography
- Dry eye syndrome

Pupil Size

- Large pupils/glare

Corneal Refractive Surgery

Radial Keratectomy (RK)

- Developed in 1976 by Svyatoslav Fyodorov MD
- Radial corneal incisions in spoke-like pattern
- Diamond knife
- Incisions deep (90%)  
- Corrects myopia and astigmatism

RK

- Complications
  - Corneal perforation
  - Irregular astigmatism
  - Late wound opening and infection
  - Late hyperopic shift
  - Hyperopic shift in high altitude
  - Dr. Back Weather – Mt. Everest 1996
LASIK (Laser Assisted in situ Keratomileusis)

- Wide range of treatable refractive errors
  - Myopia: up to +4D sphere / ±4D astigmatism (18 yrs or older)
  - Hyperopia: up to +5D sphere / ±5D astigmatism (21 yrs or older)
  - Mixed Astigmatism: up to ±6D (21 yrs or older)

- Cornea needs to be thick enough
- Caution with irregular corneas
- Aberrations with higher powers
- Higher regression with hyperopia
- Dryness issues
- Glare around lights at night

- Cornea needs to be thick enough
- Caution with irregular corneas
- Aberrations with higher powers
- Higher regression with hyperopia
- Dryness issues
- Glare around lights at night

- Cornea needs to be thick enough
- Caution with irregular corneas
- Aberrations with higher powers
- Higher regression with hyperopia
- Dryness issues
- Glare around lights at night

- Cornea needs to be thick enough
- Caution with irregular corneas
- Aberrations with higher powers
- Higher regression with hyperopia
- Dryness issues
- Glare around lights at night
**LASIK Procedure**

- Topical anesthesia
- Keratome or Femto laser to create flap
- Excimer laser to reshape cornea
- Reposition flap on surface

---

**LASIK Post Op**

- Quick recovery
- Antibiotic and steroid drops x 1 week
- Artificial tears x 1 – 2 months

---

**PRK**

(Photorefractive Keratectomy)

- Myopia - up to -6D sphere / 1D astigmatism (18yrs or older)
  up to -12D / 4D astigmatism (25yrs or older)
- Hyperopia - between +1D to +6 D / 1D astigmatism (25yrs or older)

---

**PRK**

- Better option than LASIK when:
  - Thin corneas
  - Irregular corneas
  - Dry Eye Syndrome
  - Sports or work trauma possible

**PRK**

- Topical anesthesia
- No flap
- Alcohol well to remove epithelium
- Laser reshapes cornea on surface
- Central corneal scratch at end of procedure
- Bandage CL
PRK
- RGP x 3 - 4 days
- Pain pills x 3 - 4 days
- Remove RGP
- Slow visual recovery
- Topical antibiotic x 5 days
- Topical steroids x 3 months

CustomVue / Wavefront Technology
- Wavefront instrument
- Refractive error
- Higher order aberrations
- Personalized treatment
- More precise
- Reduces higher order aberrations
- Reduces night glare

Epi - LASIK
- Topical anesthesia
- Epi-keratome used to remove epithelium with its BM in a hinged sheet
- Epithelium flapped back
- Excimer laser performed
- Epithelium repositioned
- BSCCL placed over eye
- Replace epithelium vs Remove epithelium

LASEK (Laser Assisted Epithelial Keratomileusis)
- Topical anesthesia
- Alcohol well to loosen epithelium
- Epithelial sheet detached and flapped back
- Excimer laser ablation performed
- Epithelium slide back in place
- BSCCL placed on eye

Astigmatic Keratectomy (AK)
- Paired transverse corneal incisions on steepest meridian
- Flattens corneal in steeper meridian to reduce astigmatism
- Performed with blade
Limbal Relaxing Incisions (LRI)

- Femtosecond Laser incisions
- Periphery of cornea
- Flattens steepest meridian
- Corrects astigmatism

Small Incision Lenticule Extraction (SMILE)

- Developed in 2011
- Corrects:
  - Myopia (-0.50D to -10.00D)
  - Hyperopia
  - Astigmatism (0 to 5.00D)

Small Incision Lenticule Extraction (SMILE)

- Femtosecond laser to create corneal lenticule
- Laser to create 2.4mm tunnel to corneal surface
- Lenticule extracted thru small incision with forceps

SMILE Advantages

- Faster recovery of post op Dry Eye
- Faster reinnervation of corneal nerves
- No flap needed
- Outer corneal layers intact = biomechanical stability

SMILE Disadvantages

- Moe difficult to identify low power lenticules to remove
- Enhancements vs PRK vs thin flap LASIK = not repeat SMILE
- No hyperopia in US = regression
SMILE

- 85% of all patients with a preoperative best-corrected visual acuity of 20/20 or higher achieved uncorrected visual acuity of 20/20 or higher after surgery.

Lens Implant Procedures

Refractive Lens Exchange (RLE)

Cataract Surgery

RLE

- Off label
- Presbyopic patients
  - Hyperopia
  - Myopia

RLE Advantages

- Corrects hyperopia better than any other procedure
- Better option with high refractive powers
- Better option with thin or irregular corneas
- Corrects high amounts of astigmatism
- Stable long term refractive outcome
- Quick visual recovery

RLE Disadvantages

- Eliminates any accommodation
- Higher risk of RD than other procedures
- Secondary membrane

Intracocular lens
RLE
- Removal of natural lens with intraocular lens implant (IOL)
- Same procedure as cataract surgery
  - Topical anesthesia
  - Small incision ≤3mm
  - Capsulorhexis
  - Phacoemulsification
  - IOL insertion

RLE
- Monofocal IOL
- Toric IOL
- Expanded range / Multifocal IOL
  - Femtosecond Laser

RLE – Monofocal IOL
- Corrects pre-existing hyperopia & myopia
- Distance Vision IOL
- Does not correct astigmatism
- Will need reading glasses

RLE – Toric IOL
- Corrects astigmatism
- Corrects pre-existing hyperopia & myopia
- Monofocal & Extended Range/Multifocal options

RLE – Extended Range / Multifocal IOL
- Corrects pre-existing myopia & hyperopia
- Toric options for astigmatism correction
- Corrects Distance Vision & Functional Near Vision
Femtosecond Laser

- Used in conjunction with cataract surgery or RLE
  - Monofocal IOL
  - Toric IOL
  - Expanded range IOL
  - Laser incisions
  - Laser capsulorhexis
  - Laser lens fragmentation
  - Laser relaxing incisions for astigmatism

Implantable Collamer Lens (ICL)

- Corrects high myopia: -3.00 to -20.00
- Does NOT correct astigmatism
- Collagen/silicone implant

ICL

- Laser iridotomy 5 week prior to ICL
- Topical anesthesia
- < 3mm incision
- ICL placed in sulcus

ICL Advantages

- Better visual quality than LASIK in high myopia
- Does not reduce accommodation
- Alternative to LASIK when thin or distorted cornea
- Potentially reversible
ICL Disadvantages

- Does not correct astigmatism
- Does not correct hyperopia
- Increased risk of RD & cataract when compared to LASIK

Intacs

- Flattens full thickness of central cornea
- Myopia
  - $-3.00$ to $-5.00$ D
  - No astigmatism correction
- Keratoconus
  - Fully or partially correct myopia & astigmatism
- Post LASIK ectasia

Intacs

- Topical anesthesia
- Create circular intrastromal tunnel (manual or laser)
- Insert plastic ring in tunnel

Intacs Advantages

- One of few treatments for keratoconus
- Intacs along with CXL offers best treatment to stop keratoconus progression
- Flattens cornea without removing tissue
- Potentially reversible

Intacs Disadvantages

- Does not correct astigmatism
- Cornea needs to be $450 \mu m$ at tunnel
- Limited prescription range for myopia
KAMRA

- Correction of presbyopia
- Indications:
  - Age 45-66 yrs
  - Refraction: +1.50D to -0.75D
- 3.8mm black disc / 1.6mm central aperture
- Increases depth of focus
- Pinhole effect

KAMRA

- Implanted in non-dominant eye
- Unlike monovision, still allows good distance vision

KAMRA

- Femtosecond laser to create corneal pocket
- KAMRA inlay slipped into pocket and centered

KAMRA Advantages

- Increases range of vision
- Maintains good distance vision
- Reversible
KAMRA Disadvantages

- Limited to emmetropic patients
- Only 1 eye for near
- May require months for neuro adaption

Radio Frequency Procedures

Conductive Keratoplasty (CK)

- FDA approval 2004
- Age 30 and older
- Radiofrequency energy to cornea
- Stromal temperature increases to 150°
- Corrects:
  - Low Hyperopia
  - Presbyopia

Conductive Keratoplasty (CK)

- Topical anesthesia
- Hand held probe
- Spots placed at 6, 7, or 8 mm diameter circle
  - 8, 16, 24, 32 spots
- Radiofrequency energy causes localized temperature increase
- Controlled shrinkage of cornea collagen
- Central curvature steepening

CK Advantages

- No tissue removal or thinning
- Less costly
- Can be used in thin corneas, previous LASIK, keratoconus
CK Disadvantages

- Regression
- Results may last only a few months
- Limited hyperopic range +1.50D or less
- Monovision for hyperopia

THANK YOU