LASIK Surgery
Outcomes and Enhancements

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Disclosures

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How long does LASIK surgery last?

• Common question from patients
• 10 years? 15 Years?
• What is the risk of needing an enhancement?
• There have been 16 million LASIK surgeries done
• Are center has done 50,000 surgeries since 1998
How long does LASIK surgery last?

- **Distance VA only**
  - Assume all patients have a stable Rx prior to Sx
- **Google Search reveals numerous answers**
  - Permanent, with a small chance of regression
  - 6% risk for enhancement surgery
  - One percent risk for every year post-LASIK
Long Term LASIK study

  - Spain, Visx 20/20 laser
  - 46% were within one diopter of goal
  - Regression for moderate to high myopia was -1.66 ± 2.15 diopters (D) over 15 years

- Drawbacks of study
  - Old generation laser, microkeratome
  - High myopia and astigmatism
Long Term LASIK Study

- Ikeda et al. 12 Year follow up of LASIK for moderate to high myopia. Biomed Research Inst: 2017 Japan
- 68 eyes, LASIK surgery with Visx Star S2 Laser
- 75% were within 1 diopter of correction at 12 years
- Manifest refraction changes of \(-0.74 \pm 0.99\) D occurred from 3 months to 12 years after LASIK
- Drawbacks of this study
  - Star S2 Laser, microkeratome
  - Standard ablations
Journal Review of Outcomes

- **Pokroy**, Myopic LASIK retreatment: Incidence and associations. JCRS 2016
  - 9177 Consecutive LASIK cases between 2005 and 2012
  - 1.8% had an enhancement
  - Alegretto 200 Laser and LSX 200 laser
    - Microkeratome
  - Retreatment rate decreased with time
    - 2.58% to 0.38%
Modern LASIK Outcomes
Sandoval, HP et al. JCRS 2016; 42 1224-1234

• LASIK articles published between 2008 and 2015 that contain clinical outcomes and data were reviewed.
  ▫ 97 Articles
  ▫ 67983 eyes
    • Loss of 2 or more lines: 0.61%
    • Visual acuity of 20/40 or better: 99.5%
    • SPH Equiv Refraction within 1 Diopter: 98.6%
    • SPH Equiv Refraction with 0.5 Diopter: 90.9%
    • Patient satisfaction: 98.8%
Long Term LASIK Studies

• Patel et al. 2000: 16% retreat rate
• Hersch et al. 2003 10.5% retreat rate
• Randelman et al. 2009 6.3% retreat rate
• Pokroy, et al. 2016 1.8% retreat rate
St. Louis TLC 1 Year Results

- **Alcon Wavelight Laser**
  - Contoura Topographical Laser Ablation
    - 94% of patients see 20/20
    - 99% of patients see 20/40
    - 30% of patients see 20/15
    - < 1% of patients seek out enhancement surgery
TLC St. Louis Retrospective Review

- Reviewed charts of patients who proceed with enhancement surgery within last year
  - 47 enhance surgeries between June 2016-June 2017
  - Primary Sx between the year 2000 to 2017
  - Excluded patients who had Sx with another surgeon
  - Lasers
    - Visx Star S2, Star S3, Star S4, Wavelight EX 500
How long ago did they have LASIK?

47 Patients

Years out from Surgery

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Visual Acuity at time of Enhancement Surgery

Number of patients

Visual Acuity

20/20 20/25 20/30 20/40 20/50 20/60 20/70 20/80 20/100 20/200

Visual Acuity
Refraction at time of Enhance Sx

- 9 Hyperopes, 2 mixed cyl, 36 CMA
- Average
  - Myopic Sph -0.71
  - Cylinder -0.45
  - Hyperopic Sph +1.34
- Range
  - +2.25 to -2.25 Sph
  - 0 to -1.25 Cyl
Refraction at time of Enhance Sx

![Bar graph showing refraction data]

- Eyeglass prescription:
  - Greater than +2.25: 0 eyes
  - +2.25 to +1.25: 5 eyes
  - +1.25 to +0.25: 10 eyes
  - 0 to -0.75: 25 eyes
  - -0.75 to -1: 5 eyes
  - -1 to -1.75: 20 eyes
  - -1.75 to -2: 15 eyes
  - -2: 20 eyes
Not everyone who regresses does an enhancement surgery.

- Some patients have a high tolerance for blur
  - Some have no tolerance
- Average age of patient
  - 39 Years Old
- Range
  - 21 to 59
  - Only 6 patients had bilateral surgery
- Lose track of patient
Risk Factors

• What are the pre-operative risk factors for needing an enhancement surgery?
Journal Review of Risk Factors

  - 9177 Consecutive LASIK cases between 2005-2012
  - 1.8% had an enhancement
  - Risk Factors
    - Highly near sighted, high astigmatism
    - Older age
Journal Review Risk Factors for LASIK Enhancement

• Risk Factors for Retreatment Following Myopic LASIK with Femtosecond Laser and Custom Ablation for the Treatment of Myopia. *Kruh JN*¹,² *Semin Ophthalmol.* 2017;32(3):316-320 Boston, MA
  ▫ Risk Factors
    • Age >40
    • High Myopes
Pre-Op Risk Factors


• Risk factors
  - Rx greater than -5.00
  - Smaller OZ <6.0 mm
  - Ocular fixation stability
Other factors

- Hx of RGP Wear

- Depression
  - Hersh, PS. Incidence and associations of retreatment after LASIK. Ophthalmology 2003 Apr;110(4):748-54.

- Monovision
Depression and LASIK

- Compared satisfaction in visual results of LASIK with depressive symptoms
- Patients with higher levels of depressive symptoms were 3X more likely to be unsatisfied with visual results
St. Louis Retrospective Review

- Pre-operative RX
- Age, Femtosecond flap, Monovision
- Gender, Cataracts, Peri-operative complications, Anti-depressants
St. Louis Retrospective Review

- **Pre-op Sphere**
  - Avg: -3.89
  - Range: +2.25 to -8.75
  - 21% had high myopia
    - Control 3%
- **Pre-op Cylinder**
  - Avg: -0.87
  - Range: 0 to -3.75
  - 4% had high astig (-3.75 to -3.00)
St. Louis Retrospective Review

- **Age of patients at time of Sx**
  - Average: 39
    - Control 36.58
  - Range: 21 to 59
  - 7 eyes (15%) 50-59 years old
    - Control 8%
  - 3 eyes (6%) 20-29 years old

- **Primary Surgery**
  - LASIK 76%
  - PRK 24%
St. Louis Retrospective Review

- Depression
  - 3%
- Gender
  - 48% Female 52% Male
- Monovision/ mini monovision
  - Yes 23%
  - No 77%
- Trace NS
  - 3%
Who comes back for repeat surgery?

- Monovision patients
- High myopia
- Older patients

- *Pachymetry and ablation depth were not significant findings*
Does regression occur with LASIK or are these natural changes to the eye?
Vision changes with age

- Vision changes with age
  - Study of myopia. 20-40
    - Slight myopic shift with age
  - Beaver Dam Study Age 43-59
    - +0.48 Hyperopic shift
  - Beaver Dam Study
    - Age 70+
      - -0.19 Myopic shift

Refraction at time of Enhance Sx

- 2 Hyperopes regressed back to plus
- 36 CMA regressed to minus
- 2 CMA patients developed mixed cyl
- 7 CMA became hyperopic

- Average age of 39

47 patients
Epithelial Hyperplasia

- Potential etiology of regression
  - Epithelium thickness measured pre-operatively and between 3 and 6 months
  - Epithelium thickened in the central 6mm
    - Greater with highly myopic Rx
  - Epithelium tends to restore its original contour

Changes in cornea after LASIK

- Corneal structural change after LASIK
  - Forward shift of the cornea
  - Greater changes with higher myopic corrections
Corneal curvature changes?

- **Long term RX stability**
  - Change in keratometry post LASIK 8 years
  - Spherical equivalent RX and VA
  - Regression was noted
    - Greater with high myopia
    - Kim et al. Change in keratometry after myopic LASIK and PRK. JCRS 2014;40(4):564-74
Regression with Smaller OZ

- PRK surgery
  - 4mm OZ, 5mm OZ, 6mm OZ
  - Larger OZ reduced regression and night vision problems
  - Greater with higher prescriptions
- Smaller OZ diameter ablations had greater regression
  - Rajan, Effects of ablation diameter on long-term refractive stability and corneal transparency after PRK. Ophthalmology 2006
Why do the eyes regress after LASIK?

• Proposed etiology
  ▫ Epithelial hyperplasia
  ▫ Smaller optical zone ablations
  ▫ Lenticular nuclear sclerosis
  ▫ Forward shifting of the cornea
What can we do to prevent regression after LASIK?

- New Technology compared to technology from 10 years ago
  - Variable spot lasers vs Standard Laser
  - Microkeratome vs Femtosecond Flap
  - 6.5 mm Optical Zone vs 5.0 mm OZ
  - Topographical guided vs Standard Ablation
Lower risk for Enhancement Sx

- Technology
  - EX 500
    - Topographical ablation
  - FS 200
- Conservative parameters
  - Know your limits
- Surgical Experience
Nomogram Adjustments

- Myopic patients under age 30
  - Shoot for +0.25 Goal OU
- Patients age 31-44
  - Shoot for plano Goal OU
- Patients over age 45
  - Shoot for -0.25 to -0.50 goal in non-dominant eye
When to Enhance?

- When patient becomes symptomatic
- When RX is stable
- Decreased uncorrected visual acuity
  - 20/40 Vision
- Spherocylinder correction
  - -1.00 Sphere or higher
  - -1.00 Cylinder or higher
  - +1.00 SPH
When **NOT** to Enhance

- 20/20 vision
- Corneal Thickness
- Corneal Curvature
- Topography
- Cataract
- Unrealistic Expectations
When **NOT** to Enhance

- Post-operative corneal thickness
  - **PRK**
    - 350 Residual Bed
    - 400 with epithelium
- PRK Enhancement over LASIK
- Risk of Keratectasia
PRK Enhancement over LASIK

- Laser anterior stromal tissue
  - Anterior portion of pre-existing flap
  - Removing epithelium
  - Laser stromal tissue
  - Careful not to laser through the flap

Flap=120 Microns
Corneal Topography

- Early signs of keratectasia
  - Myopia and irregular astigmatism
  - Inferior steepening
  - Posterior corneal float
  - Enhancement surgery will only make it worse
Enhancement Surgery

- Regression secondary to cataract
  - Nuclear sclerosis
    - Myopic shift in RX
  - Cortical Cataract
  - PSC
PRK Retreats over LASIK Flaps

- **PRK Surgery**
  - Remove epithelium
    - No brushes
  - Laser ablation
  - Contact lens X 5 days

- **Disadvantages**
  - Longer VA recovery
  - More discomfort
  - Unilateral surgery
Prolonged Visual Recovery

• Patients need to be prepared for long vision recovery
• Five days of blurry vision with bandage CL
• 2 weeks before vision is ~ 20/30
• 1-2 Months before some patients reach 20/20 vision
Prolonged Visual Recovery

- Six months before you reach end point
- Longer visual recovery
  - Hyperopes
  - Mixed astigmatism
  - Older patients
Visual results for enhancement Sx

- 3 Months Post-Op
  - 20/15  8%
  - 20/20  63%
  - 20/25  17%
  - 20/30  8%
  - 20/40  4%
Risk Factors for PRK enhancement

- Infection
- Non-healing defect
- Recurrent erosions
- Corneal haze
  - Mitomycin C
When do patients come back for enhancement surgery?

- Depends on when they had the surgery
  - Technology used, age at time of surgery, monovision
- What is the percentage risk for today's patients?