“Refractive Surgeries” 👁️

Introduction

- Refractive surgeries are procedures (surgical or laser-assisted) on the cornea or lens.
- Corneal surgeries are far more common than lens-based ones.
- Principle: Alter the corneal curvature → change refractive power.
- Some eyes cannot undergo surgery due to contraindications.

History of Refractive Surgery 📜

- 1965: Radial Keratotomy (RK) – Fyodorov
- 1970: RK further developed – Slade / Brint
- 1983: Keratomileusis introduced – José Ignacio Barraquer
- 1991: Excimer Laser invented

- 1996: PRK & LASIK approved by FDA
- 2001: Femtosecond Laser introduced

Summary: Evolution → RK → Keratomileusis → Excimer Laser → PRK → LASIK → SMILE/Femtosecond laser.

Classification of Refractive Surgeries

Cornea-based procedures:

- RK
- PRK
- LASIK
- SMILE

Lenticular-based procedures:

- Phakic IOL
- Clear Lens Extraction (>45 years)
- Bioptics (Combination of cornea + lens surgery)

Preoperative Assessment 📝

1. History

- Age: Ideal 20–45 years
  - <20 → higher chance of unstable refraction
  - 45 → presbyopia + possible cataract changes

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2. Stabilization of Refraction

- Surgery should only be done if refractive errors stable for ≥1 year.

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3. Contraindications 🚫

Absolute Contraindications:

- Infection
- Keratoconus
- Glaucoma
- Posterior segment anomalies

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- Immunosuppression
- Corneal dystrophies
- Amblyopia

Relative Contraindications:

- Dry eyes
- Allergic keratoconjunctivitis
- Diabetes mellitus
- Pregnancy

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4. Visual Acuity & Refraction

Pin-hole test:

- No improvement → Organic pathology / Amblyopia
- Improvement → Refractive error ✅ → Candidate for surgery ✅

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5. Visual Acuity & Refraction

Steps of Assessment:

1. UAVA – Uncorrected Visual Acuity
2. Objective Measurement of Refractive Error – Autorefraction / Retinoscopy
3. Subjective Assessment & BCVA – Best-Corrected Visual Acuity

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Important Notes

- Cycloplegia should be performed in all cases to neutralize accommodation and refine the spherical component.
- Pin-hole test still helps distinguish refractive errors vs organic pathology.

Reference Ranges (American Academy of Ophthalmology, 2022–2023)

Surgery	Sphere (D)	Cylinder (D)
LASIK	+5.00 to –14.00	Up to 5.00
PRK	+6.00 to –12.00	Up to 4.00
Phakic IOL	–3.00 to –20.00	Up to 4.00 (Toric lens)
Refractive Lens Exchange	All ranges	Up to 4.00 (Toric lens)

Tip: Sphere = nearsightedness/farsightedness, Cylinder = astigmatism correction.

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6. Identify Co-Pathologies (Before Surgery) 🔍

Cornea:

- Corneal dystrophy
- Corneal vascularization
- Active HSV infection
- Corneal ectasia / Keratoconus

Lens:

- Cataract
- Anterior or Posterior Lenticonus
- Lens Subluxation

Pre-ocular Tear Film:

- Tear meniscus height
- Tear film break-up time
- Schirmer test

  Exclude: Severe dry eye or autoimmune disease

Fundus Examination:

- Dilated fundus exam using VOLK 90D lens is essential for all cases

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Flowchart: Co-Pathology Screening →

Preoperative Screening

- Cornea → Check for dystrophy, vascularization, HSV, keratoconus ❌
- Lens → Check for cataract, lenticonus, subluxation ❌
- Tear Film → Schirmer test, TBUT → Exclude severe dry eye / autoimmune ❌
- Fundus → Dilated Fundus Exam (VOLK 90D) ✅

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7. Investigations 🧪

Corneal Tomography (Pentacam – OCULUS)

- Maps & Measurements:
    1. Keratometry → corneal curvature
    2. Corneal thickness (pachymetry)
    3. Corneal topography maps → identify ectasia risk

Purpose: Ensures sufficient corneal thickness and rules out subclinical keratoconus, which is critical for LASIK/PRK/SMILE safety.

Corneal & Lenticular Refractive Procedures

I. Corneal Refractive Procedures

A. Radial Keratotomy (RK)

- Technique:
  - Series of 4–8 deep radial stromal incisions in the cornea.
  - Weakens paracentral & peripheral cornea → flattens central cornea.
- Complications:
  - Bullous keratopathy
  - Low stability of refraction

Flowchart: RK Mechanism →

Corneal Stroma → Deep radial incisions → Peripheral & paracentral weakening → Central corneal flattening → Refraction corrected

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B. Photorefractive Keratectomy (PRK)

- Technique:
  - Remove outer corneal epithelium
  - Apply Excimer laser to ablate corneal stroma
  - No flap created
- Recovery:
  - Vision improves over 7–21 days
  - Discomfort present during healing
  - Longer recovery (>2 weeks)

Flowchart: PRK Steps →

Corneal Epithelium Removed → Excimer Laser Applied → Corneal Surface Heals → Vision Improvement

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C. LASIK (Laser-Assisted In Situ Keratomileusis)

- Most commonly performed refractive surgery
- Technique:
    1. Flap creation (mechanical or femtosecond laser microkeratome)
    2. Excimer laser ablation of underlying corneal stroma
    3. Flap repositioned

Flowchart: LASIK Steps →

Corneal Flap Created → Excimer Laser Applied to Stroma → Flap Returned → Vision Corrected

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D. PRK vs LASIK Comparison

Feature	PRK	LASIK
Flap creation	❌ No	✅ Yes
Recovery	Longer (7–21 days)	Shorter (1–3 days)
Discomfort	Moderate	Mild

Most suitable	Thin corneas, low-moderate errors	Most cases

E. SMILE (Small Incision Lenticule Extraction)

Introduction

- SMILE is a minimally invasive, flapless laser refractive surgery.
- Performed with a femtosecond laser to correct myopia and myopic astigmatism.
- It is considered the next-generation alternative to LASIK.

Principle

- A lenticule (lens-shaped piece of corneal stroma) is cut inside the cornea using a femtosecond laser.
- The lenticule is extracted through a small incision (~2–4 mm), which reshapes the cornea to correct refractive error.

Key Point: No corneal flap is created → preserves corneal biomechanics and reduces dry eye risk.

Indications

- Myopia: up to −10.0 D
- Myopic astigmatism: up to −5.0 D cylinder
- Patients with thin corneas unsuitable for LASIK
- Patients who want flapless surgery and faster recovery

Steps of SMILE Surgery

1. Femtosecond laser cuts the lenticule inside the corneal stroma
2. Small side incision (2–4 mm) is created
3. Lenticule is extracted through the incision
4. Corneal shape is altered → refractive error corrected

Flowchart: SMILE Procedure →

Femtosecond Laser → Lenticule Cut in Corneal Stroma → Side Incision Created → Lenticule Extracted → Cornea Reshaped → Vision Corrected ✅

Advantages over LASIK

- Flapless → no flap complications
- Better corneal biomechanical stability
- Reduced postoperative dry eye
- Minimal disruption to corneal nerves
- Suitable for thin corneas

Disadvantages / Limitations

- Limited to myopia and myopic astigmatism
- No enhancement easily possible if undercorrection occurs (enhancement requires LASIK or PRK)
- Slightly longer learning curve for surgeons

Complications

- Early:
  - Cap lenticule interface haze
  - Small residual lenticule fragments
- Rare:
  - Infection
  - Ectasia (very rare due to flapless technique)
  - Undercorrection or overcorrection

High-Yield Summary

- SMILE = minimally invasive, flapless femtosecond laser surgery
- Corrects myopia/myopic astigmatism
- Preserves corneal integrity and reduces dry eye risk
- Small incision → faster recovery and fewer complications than LASIK

F. Common Laser Vision Correction Complications

- Under/over correction
- Epithelial trauma (PRK)
- Flap complications (LASIK)
- Corneal ectasia
- Unwanted astigmatism

Equipment: Excimer & Femtosecond laser machines (SCHWIND, SCHUIND, SMILE)

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2. Lenticular Refractive Procedures

A. Phakic Intraocular Lenses (IOLs)

- Definition: Artificial lenses implanted in the anterior or posterior chamber with the natural lens intact to correct refractive errors.
- Types:
    1. Anterior Chamber Iris-fixated IOL (Artisan)

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2. Posterior Chamber IOL (ICL)

Illustration:

- AC iris-fixated → attached to iris in anterior chamber
- PC IOL → placed behind iris, in posterior chamber

B. Complications of Phakic IOLs

Type	Complications
AC IOL	Pupillary block, Dislocation, Secondary glaucoma, Iritis
PC IOL	Pupillary block, Dislocation, Secondary glaucoma, Iritis, Cataract

Flowchart: Phakic IOL → Complications →

Phakic IOL
– AC Type → Pupillary block / Dislocation / Glaucoma / Iritis
– PC Type → Pupillary block / Dislocation / Glaucoma / Iritis / Cataract

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-> The End <-

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