INTERNATIONAL CONGRESS OF THE
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# Updates in Ophthalmology

## The SMILE surgery procedure, as a preventive strategy for Keratoconus

**Dr. José Lamarca**
UIC Barcelona
UVIC

BARRAQUER

# SMILE

**SMILE (Small Incision Lenticule Extraction ):**

- SMILE is a newer technique compared to PRK and LASIK, having been approved in many countries in the early 2010s.
- **Estimated** : More than 1 million SMILE procedures have been performed worldwide. SMILE's popularity is growing, especially in Asia and Europe.

# History and Concept of SMILE

- SMILE (Small Incision Lenticule Extraction) was first introduced by Sekundo and Blum in 2006 and received FDA approval in 2016 for the treatment of myopia and astigmatism. It represents the evolution from microkeratome-based LASIK and surface ablation (PRK) to a flapless, keyhole surgery using femtosecond laser technology. SMILE was developed to minimize flap-related complications and preserve corneal biomechanical integrity.
- Source: Sekundo W et al. J Cataract Refract Surg. 2011;37(5):991–997.

# Femtosecond Laser Principles

- Femtosecond lasers deliver ultra-short pulses (10^-15 s) of infrared light (typically 1040–1060 nm), focused to a precise depth in the corneal stroma. They create cavitation bubbles that separate tissue layers without thermal damage.
- In SMILE, two lamellar cuts are performed: one posterior for the lenticule base, and one anterior cap. The lenticule is extracted through a 2–4 mm side-cut incision.
- Source: Lubatschowski H. J Refract Surg. 2000;16(5):S643–S648.

# Laser Parameters and Lenticule Design

- The posterior lenticule plane is created at ~130–150 µm depth, while the anterior plane defines the cap.
- Cap thickness is typically 110–130 µm.
- Lenticule diameter ranges from 6.0–6.8 mm depending on the optical zone.
- Spot energy is 120–160 nJ, spot spacing 4.5–5.0 µm, balancing precision and tissue resistance.
- Energy less than FS LASIK (variable)
- Deeper caps reduce biomechanical disruption; shallow caps may ease extraction but compromise nerve integrity.

- Source: Reinstein DZ et al. J Refract Surg. 2010;26(11):769–776.

# VisuMax 800 Platform (Zeiss): Next-Generation SMILE

- The VisuMax 800 offers high-speed 2 MHz laser pulses, reducing procedure time significantly.
- Real-time eye tracking, improved centration tools, and intelligent patient interface increase precision and comfort.
- VisuMax 800 integrates with ZEISS CALLISTO, IOLMaster 700 and CIRRUS OCT, enabling guided centration and preloaded surgical planning. SMILE data merges with biometric tools for refractive precision.
- Source: ZEISS Meditec documentation, 2023.
- Its software enables refined centration over visual axis and cyclotorsion compensation, crucial in astigmatism correction.
- Source: Zeiss Meditec. Product Manual and Clinical Whitepapers, 2022–2024.

# VISUMAX 800

- Treatment time

Lenticulum completed : < 10 sec*
Flap creation : approx . 6 sec**

**Advantages**

- The patient needs to concentrate only for a short time
- More flexibility for optimizing shot distance parameters
- Total suction time is reduced
  Less time for suction losses to occur

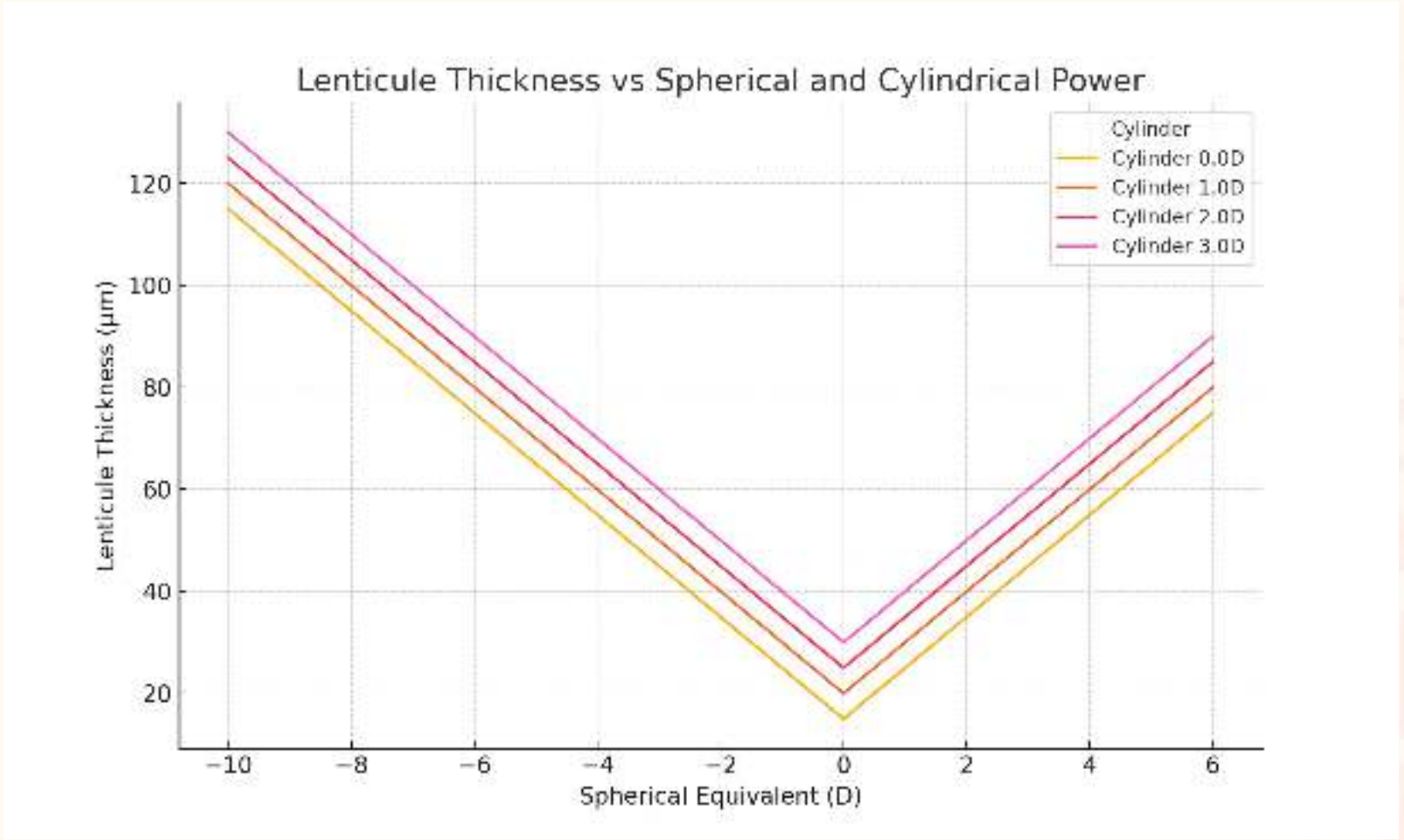
# Indications and Contraindications

- Indications include myopia up to -10.00 D and astigmatism up to -3.00 D. Emerging protocols include hyperopia correction and retreatment options.

- SMILE is ideal for patients with stable myopia, no signs of corneal ectasia, and healthy ocular surface. It is preferred for patients with active lifestyles or at risk of trauma due to flap-free nature.

- Contraindications: forme fruste keratoconus, unstable refraction, thin corneas (<480 µm), dry eye syndrome, autoimmune diseases. Preoperative evaluation must include tomography, epithelial mapping, and biomechanical risk indices.

- Source: Moshirfar M et al. Clin Ophthalmol. 2020;14:2199–2210.


Lenticule Thickness vs Spherical and Cylindrical Power
Cylinder
Cylinder 0.0D
Cylinder 1.0D
Cylinder 2.0D
Cylinder 3.0D
Lenticule Thickness (µm)
120
100
80
60
40
20
−10
−8
−6
−4
−2
0
2
4
6
Spherical Equivalent (D)

# Patient Selection Criteria

- SMILE is ideal for patients with stable myopia, no signs of corneal ectasia, and healthy ocular surface. It is preferred for patients with active lifestyles or at risk of trauma due to flap-free nature.

- Source: Moshirfar M et al. Clin Ophthalmol. 2020;14:2199–2210.

# Anatomical Benefits of SMILE

- Preserves the anterior corneal lamellae and subbasal nerve plexus

  Better biomechanical integrity
  Less postoperative dry eye.
  Reduction neurotrophic complications
  Faster epithelial recovery.

- Source: Xia L et al. Am J Ophthalmol. 2015;160(5):893–900.

# Biomechanical and Neural Advantages

- Finite element models show SMILE induces 50–70% less biomechanical weakening than LASIK due to its deeper lenticule position and smaller incision.
- Confocal microscopy reveals greater preservation of corneal nerves and less inflammatory response. This correlates with reduced dry eye symptoms and better long-term stability.

- Source: Randleman JB et al. J Cataract Refract Surg. 2013;39(11):1880–1888.

# Intraoperative Complications in SMILE

- Lenticule descentration
- Suction loss and lenticule drop.
- Incomplete cuts
- Lenticle tears
- Cyclotorsion?

- Source: Vestergaard A et al. J Cataract Refract Surg. 2014;40(10):1758–1767.

# Postoperative Complications and Their Management

- Inflammation (DLK-like) and haze

  Inflammation is treated with topical corticosteroids. Lenticule interface opacity is rare and usually resolves with time or interface irrigation.

- Epithelial ingrowth
- Residual refractive error.  (Re-SMILE, circle or PRK touch-up may be performed after 3–6 months. )

- Source: Ang M et al. Clin Ophthalmol. 2017;11:2015–2021.

# Corneal Ectasia After SMILE: Risk and Prevention

- Ectasia after SMILE is rare but documented.
- Contributing factors include
  - undiagnosed keratoconus
  - Thin residual stromal bed (<250 µm)
  - Abnormal biomechanics.
  - Preoperative screening using Belin/Ambrosio D-index, CBI, and TBI is essential.
- Biomechanical models show SMILE maintains greater structural integrity than LASIK.

Source: Vinciguerra R et al. J Refract Surg. 2020;36(2):110–115.

# New Developments: SMILE Pro and Hyperopia Correction

- Clinical trials show feasibility for +1.00 to +3.50 D corrections with stable outcomes.
- Source: Sekundo W et al. Ophthalmology. 2023;130(1):15–23.

# SMILE Surgical Steps

- 1. Docking and centration using the VisuMax interface
  2. Femtosecond laser creation of posterior and anterior planes
  3. Side-cut incision (2–4 mm)
  4. Dissection of lenticule interface
  5. Extraction of lenticule with forceps
- The total time is under 30 seconds for the laser phase. The flapless approach eliminates risks of flap dislocation.

- Source: Blum M et al. J Refract Surg. 2010;26(4):242–248.

# Clinical Outcomes and Patient Satisfaction

- Over 90% of SMILE patients achieve 20/20 or better.
- Patient satisfaction is high due to comfort and minimal discomfort.
- Subjective dry eye symptoms significantly lower than LASIK at 1 and 3 months.

Source: Ivarsen A et al. J Refract Surg. 2014;30(9):634–640.

## Conclusions

Procedure volumes such as LASIK, PRK, and SMILE are increasing post-pandemic.

The general trend shows that LASIK remains the most popular method, while SMILE is rapidly gaining ground and PRK/PTK is used in specific cases.

**ICL and Trifocal Lenses** : 20% growth in lens implants, especially in patients over 50 years of age.

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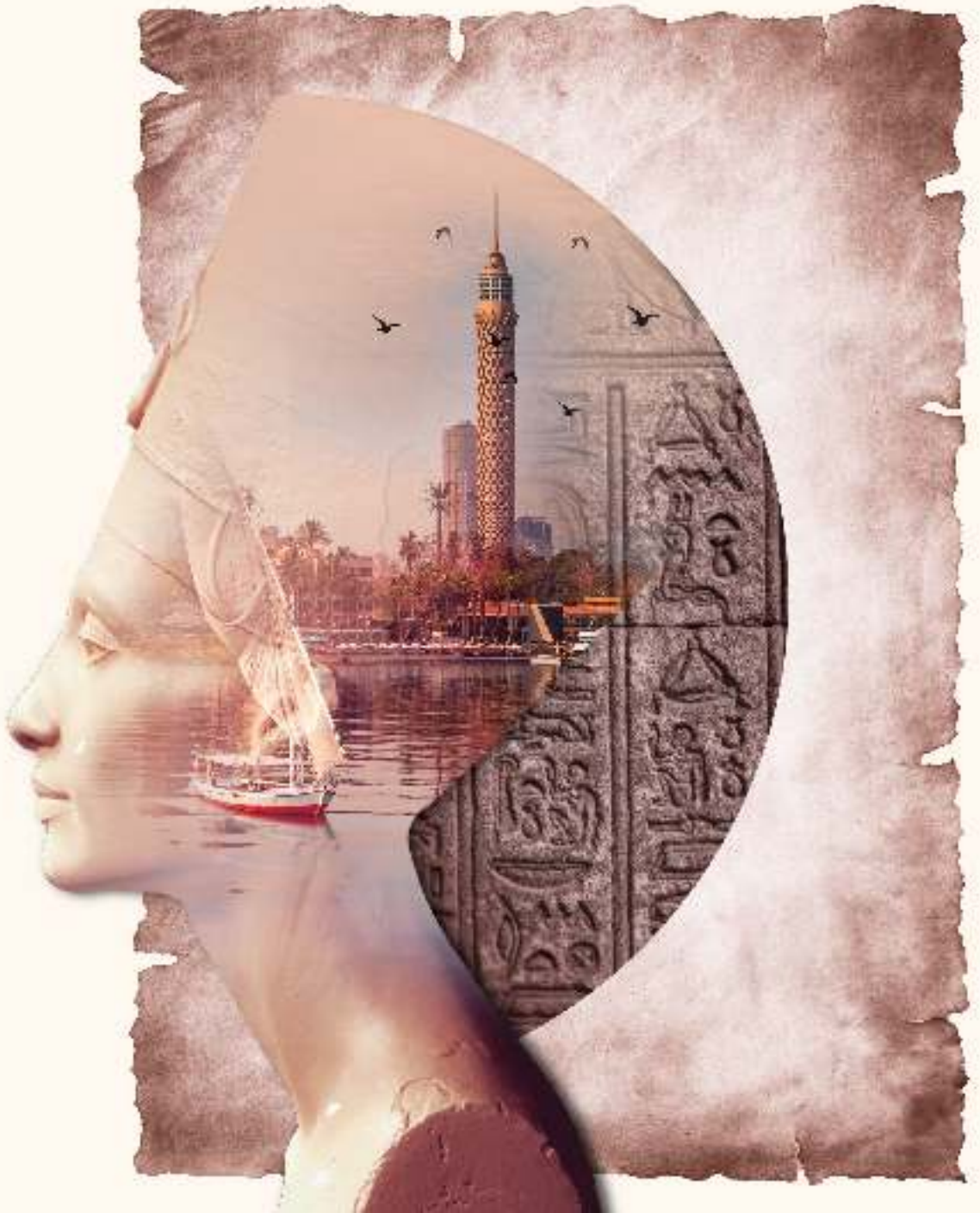
# Thank you



**Dr. José Lamarca**
**jlamarca@uic.es**
**jlamarca@barraquer.com**

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