

# EVIDENCE-BASED RECOMMENDATIONS ON KLEX



Highlights from jointly developed guidelines.

BY HUAZHENG CAO, MD, AND YAN WANG, MD, PHD

The first guidelines on keratorefractive lenticule extraction (KLEX) surgery were jointly developed by 44 top ophthalmologists worldwide and published in April.<sup>1</sup> Covering preoperative screening to postoperative complications management, the guidelines represent the first systematic operational standard for this rapidly evolving refractive surgery technique. This article highlights several key points from the publication.

## CANDIDACY

Corneal biomechanical properties influence the predictability of refractive outcomes, and the thickness of the corneal tissue removed during KLEX affects corneal biomechanical strength. Additionally, postoperative corneal biomechanical properties are associated with the optical zone diameter. For these reasons, keratoconus is a contraindication for KLEX.

The preoperative evaluation must therefore include an assessment of corneal morphology and biomechanics to detect subclinical or forme fruste keratoconus. Sensitive, currently available corneal biomechanical parameters include the tomographic and biomechanical index, Corvis biomechanical index (Oculus Optikgeräte), and corneal resistance factor.

## SURGICAL PLANNING

### Corneal Thickness

The calculation of the percentage of tissue alteration for KLEX is based mainly on lenticular thickness. For corneal thickness settings, a residual stromal thickness (RST) of at least 280  $\mu\text{m}$  and a lenticule thickness index (ie, the ratio of maximum

lenticule thickness to central corneal thickness) of 28% or less may be used as reference values. An RST of less than 250  $\mu\text{m}$  should not be allowed, and an extremely thin corneal cap ( $< 100 \mu\text{m}$ ) is not recommended.

### Optical Zone

The use of a large optical zone may result in less undercorrection after KLEX (especially in patients with high myopia). A large optical zone is also associated with fewer surgically induced higher-order aberrations, but it has an impact on postoperative corneal biomechanical strength. The guidelines therefore recommend creating a large optical zone if preoperative corneal thickness is sufficient.

### Nomogram

The surgical nomogram affects the precision and predictability of KLEX. In addition to the patient's age, nomogram settings account for the preoperative spherical equivalent; eye laterality; corneal curvature, diameter, and biomechanical properties; cap and lenticule thickness; central corneal thickness; RST; optical zone diameter; accommodation; and laser energy.

The nomogram should be adjusted for factors related to the patient, surgeon, and surgical environment. Currently, the main strategies are simple spherical and cylindrical modification, multivariate regression analysis, and AI-based personalized adjustments.<sup>2,3</sup>

## THE PREVENTION AND MANAGEMENT OF COMPLICATIONS

### Intraoperative Adverse Events

**Suction loss.** Strategies for preventing suction loss include preoperative patient education and fixation training. Intraoperatively, patients should be instructed to remain relaxed and

maintain fixation. During suction, it is important to avoid trapping conjunctival tissue, prevent the accumulation of excess water on the ocular surface and conjunctival sac, and eliminate potential distractions to the patient.

**Black spots.** The recommendations on how to prevent black spots include maintaining a clean and properly humidified ocular surface and suction ring/patient interface, avoiding repeated suction procedures, and selecting appropriate laser energy.

**Improper dissection.** To prevent the dissection of the wrong plane, the upper and lower planes should be differentiated at the incision site before lenticule dissection.

**Damage to the cap.** To prevent the perforation of or tears to the cap, excessively thin caps should be avoided, and good intraoperative fixation should be ensured by asking the patient to avoid sudden eye movements. If the cap is perforated or torn, the cornea must be tightly aligned, and a bandage contact lens should be placed.

**Lost lenticule.** If the lenticule cannot be found, a relatively sharp dissector may be used to search for the edge of the tissue. Increasing the magnification of the microscope or built-in slit lamp can facilitate the identification of the lenticule, and OCT may be used when necessary.

### Retained Lenticule Fragments

Laser energy, surgical parameters, and the temperature and humidity of the OR are set preoperatively. After lenticule extraction, its complete removal must be confirmed. Postoperatively, poor visual acuity, severe irregular astigmatism, and abnormal corneal topography are red flags for retained lenticule fragments. When fragments

## ▶ REFRACTIVE SURGERY

are discovered, especially in the optical zone, they must be thoroughly removed. Minimal residual tissue in the peripheral areas that does not affect the patient's visual acuity may be monitored.

**Perioperative Infection**

The cause and pathogen should be identified as soon as possible and antiinfective measures initiated. Inflammatory reactions should receive pharmacologic treatment. If the infection proves uncontrollable, the guidelines recommend enlarging or opening the incision, removing the lesion in the intrastromal pocket, and rinsing the pocket with antibiotics.

**Diffuse Lamellar Keratitis**

Physicians should avoid the repeated insertion and removal of instruments. The incision's position may be changed to prevent bleeding if necessary. The accumulation of oil and tears should be avoided.

Postoperatively, prophylactic glucocorticoids should be applied with regular follow-up. Infection must be differentiated from inflammation, with

routine local treatment. Patients with severe symptoms may be treated with combined medications or interlamellar steroid rinsing.

**Postoperative Corneal Ectasia**

Key strategies for preventing corneal ectasia are not to perform KLEX on individuals with abnormal corneal morphology and to instruct patients not to rub their eyes postoperatively.

After KLEX, suspected corneal ectasia in conjunction with a decline vision or a newly detected refractive error warrants a prompt examination, an evaluation of corneal thickness and posterior corneal elevation, and close observation. If there are signs of ectatic progression and visual decline, timely intervention such as CXL is recommended, and rigid gas permeable contact lens wear may improve the patient's vision.

**CONCLUSION**

The publication of evidence-based guidelines for KLEX is a pivotal step in refractive surgery's transition from experience-based to precision medicine. Ophthalmologists' adoption of these recommendations could help reduce surgical risks and improve

postoperative outcomes. Scan the QR code for comprehensive details on the methodology and implementation guidelines. ■



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1. Wang Y, Xie L, Yao K, et al; Writing Committee for the Guideline Working Group. Evidence-based guidelines for keratorefractive lenticule extraction surgery. *Ophthalmology*. 2025;132(4):397-419.
2. Cui T, Wang Y, Ji S, et al. Applying machine learning techniques in nomogram prediction and analysis for SMILE treatment. *Am J Ophthalmol*. 2020;210:71-77.
3. Liang S, Ji S, Liu X, et al. Applying information gain to explore factors affecting small-incision lenticule extraction: a multicenter retrospective study. *Front Med (Lausanne)*. 2022;9:837092.

**HUAZHENG CAO, MD**

- School of Medicine, Nankai University, Tianjin, China
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**YAN WANG, MD, PHD**

- Tianjin Eye Hospital, Tianjin Eye Institute, Tianjin Key Laboratory of Ophthalmology and Visual Science, Nankai University Affiliated Eye Hospital, Tianjin, China
- Nankai University Eye Institute, Nankai University, Tianjin, China
- Clinical College of Ophthalmology, Tianjin Medical University, Tianjin, China
- wangyan7143@vip.sina.com
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