

COMPARATIVE EVALUATION OF CONTEMPORARY LASER VISION CORRECTION TECHNIQUES IN MYOPIA

Zokirjonova Mohlaroyim Oybek qizi

Department of Ophthalmology, Andijan State Medical Institute

*Scientific supervisor: **Kasimov Ahmadjon Kamoldinovich***

Candidate of Medical Sciences, Associate Professor

Abstract. Myopia is among the most common refractive disorders and is increasingly important in modern ophthalmic practice. Corneal laser refractive surgery can substantially reduce dependence on spectacles and contact lenses, but the principal techniques differ in tissue interaction, visual recovery, ocular-surface effects and procedure-specific risks. This thesis comparatively evaluates photorefractive keratectomy and transepithelial photorefractive keratectomy (PRK/TransPRK), laser in situ keratomileusis including femtosecond and wavefront-guided variants (LASIK/FS-LASIK/WFG-LASIK), and small-incision lenticule extraction (SMILE). Current evidence indicates that these methods provide high refractive efficacy and predictability in properly selected myopic eyes, while clinically meaningful differences concern rehabilitation speed, corneal nerve preservation, residual astigmatism, higher-order aberrations and dry-eye outcomes. Individualized preoperative assessment remains the key condition for safe and effective procedure selection.

Keywords: myopia; laser vision correction; refractive surgery; LASIK; SMILE; PRK; TransPRK; cornea.

INTRODUCTION

Myopia is a refractive condition in which parallel light rays are focused in front of the retina when accommodation is relaxed, producing blurred distance vision. Its growing

prevalence has increased the demand for reliable optical and surgical correction. Glasses and contact lenses remain effective, but many adults seek refractive surgery because of occupational requirements, active lifestyle, intolerance to contact lenses or a desire for greater spectacle independence. Modern corneal laser procedures aim to reshape the cornea so that incoming light is focused more accurately on the retinal plane.

The three major surgical strategies differ substantially. PRK and TransPRK are surface-ablation procedures in which epithelial removal or transepithelial ablation is followed by excimer-laser reshaping of the anterior stroma. LASIK creates a corneal flap and applies excimer-laser ablation within the stromal bed; femtosecond systems improve flap precision, while wavefront-guided treatment can incorporate optical aberration data. SMILE uses a femtosecond laser to create an intrastromal lenticule that is removed through a small incision without formation of a large flap. These structural differences may influence postoperative pain, recovery time, corneal sensitivity, tear-film stability, biomechanical response and the profile of complications.

The aim of this thesis is to comparatively assess the principal outcomes of contemporary laser vision correction methods for myopia, focusing on refractive efficacy, predictability, safety, visual quality, ocular-surface recovery and practical criteria for individualized procedure selection.

MATERIALS AND METHODS

The work was designed as a concise comparative analysis based on the evidence summarized in the previously prepared article. Systematic reviews, meta-analyses, controlled comparative studies and authoritative safety guidance were considered. The main outcome indicators were uncorrected distance visual acuity (UDVA), corrected distance visual acuity (CDVA), manifest refraction spherical equivalent (MRSE), proportion of eyes within ± 0.50 D of the intended correction, residual cylinder, higher-order aberrations, tear-film stability, corneal sensitivity and postoperative adverse effects.

Because no authentic local patient dataset was provided, no artificial sample sizes, invented clinical observations or simulated significance values were introduced.

RESULTS AND COMPARATIVE ANALYSIS

The evidence indicates that PRK/TransPRK, LASIK/FS-LASIK/WFG-LASIK and SMILE can all achieve high levels of postoperative distance vision and refractive predictability when patients are appropriately selected. A major network meta-analysis of randomized trials found no consistent statistically significant superiority of one major laser procedure over another for overall efficacy or safety, emphasizing that final visual acuity alone is insufficient for choosing a procedure. More recent studies have clarified clinically relevant differences in astigmatic correction, optical quality, tear-film behavior and speed of rehabilitation [1-5].

LASIK and FS-LASIK are characterized by rapid early visual recovery because the central epithelium remains largely intact over the flap. This makes them attractive when fast functional rehabilitation is important. Wavefront-guided LASIK may offer additional value in eyes with myopic astigmatism because treatment planning can incorporate optical aberration information. A 2024 systematic review and meta-analysis of 976 eyes reported similar proportions of eyes reaching 20/20 or better UDVA after SMILE and WFG-LASIK, as well as similar refractive predictability. However, WFG-LASIK demonstrated favorable vector outcomes for some components of astigmatic correction and induced less coma [2].

SMILE provides a flapless intrastromal approach through a small incision. This removes flap displacement and flap-striae risks and may preserve a larger proportion of anterior corneal nerve fibers. A 2025 systematic review and meta-analysis of 18 studies found better preservation of corneal sensitivity and longer tear break-up time at several postoperative points after lenticule extraction/SMILE compared with FS-LASIK [4]. These findings support the potential ocular-surface advantage of a small-incision technique, particularly in patients with borderline preoperative tear-film function.

Nevertheless, SMILE does not eliminate the risk of dry-eye symptoms, optical aberrations, residual refractive error or the need for additional treatment.

PRK and TransPRK remain clinically relevant because they avoid a corneal flap and may be considered when flap creation is undesirable. Their main limitation is the epithelial wound, which is associated with greater early discomfort, photophobia and slower visual rehabilitation. Corneal haze is a specific surface-ablation concern, although modern techniques and prophylactic strategies have reduced its frequency. Importantly, a 2026 meta-analysis including 17 studies and 5,686 treated eyes found no statistically significant overall differences between TransPRK and LASIK/SMILE in efficacy and refractive predictability, supporting surface ablation as a valid option in selected cases [5].

Table 1. Comparative clinical profile of laser correction methods in myopia

Parameter	PRK/TransPRK	LASIK/FS-LASIK	SMILE
Early visual recovery	Slower	Very rapid	Rapid
Corneal flap	No	Yes	No
Early discomfort	Higher	Low	Low
Flap-specific complications	Absent	Possible	Absent
Ocular-surface/nerve effect	Surface healing required	Greater nerve interruption	Relatively better nerve preservation
Key strength	Flap-free surface approach	Fast rehabilitation and customization	Small-incision flapless technique

The table demonstrates that the practical distinctions between procedures concern the pathway to the final refractive result rather than a simple hierarchy of effectiveness. LASIK usually offers the fastest early recovery; SMILE combines rapid recovery with a small-incision flapless approach; and PRK/TransPRK provides a flap-free surface-ablation option at the cost of slower epithelial recovery.

DISCUSSION

The comparative findings support an individualized strategy for refractive surgery. Selection should not be based only on the preoperative spherical equivalent or on a general claim that one technology is universally superior. Stable refraction, corneal pachymetry, topography or tomography, epithelial and stromal morphology, keratoconus or ectasia risk, tear-film status, pupil characteristics, magnitude and axis of astigmatism, occupational exposure to ocular trauma and patient expectations should all be considered before surgery.

Preoperative screening is particularly important because laser refractive surgery alters corneal structure. A normal slit-lamp appearance alone cannot exclude ectatic risk. Tomographic analysis and pachymetry are required to identify suspicious corneal patterns and to estimate whether planned tissue alteration is acceptable. The ocular surface should also be stabilized before final measurements, since tear-film instability may affect keratometry, topography and wavefront data. Dry eye, blepharitis and meibomian gland dysfunction should therefore be managed before definitive surgical planning.

Postoperative evaluation should include more than standard high-contrast visual acuity. UDVA and CDVA remain essential, but they should be interpreted together with MRSE, residual astigmatism, contrast-related symptoms, glare, halos, higher-order aberrations and patient-reported quality of vision. A small statistically significant difference between procedures may not always be clinically noticeable, while an uncommon complication can be highly relevant to an individual patient. Consequently, both group-level outcomes and individual adverse events should be reported in future clinical research.

For future prospective studies at the Department of Ophthalmology, Andijan State Medical Institute, a standardized follow-up protocol would improve comparability. Baseline assessment may include UDVA, CDVA, manifest and cycloplegic refraction when indicated, slit-lamp examination, intraocular pressure, corneal pachymetry, topography/tomography and ocular-surface evaluation. Postoperative assessment at approximately 1 week, 1 month, 3 months, 6 months and 12 months would allow analysis of early recovery and longer-term refractive stability. A six-month UDVA endpoint combined with MRSE predictability, CDVA safety, residual cylinder, dry-eye measures and subjective visual-quality scores would provide a clinically meaningful outcome set.

CONCLUSION

Modern laser correction techniques for myopia are highly effective when used in carefully selected patients. LASIK/FS-LASIK offers very rapid visual rehabilitation and can be customized with wavefront-guided strategies; SMILE provides a flapless small-incision approach with evidence of relatively favorable corneal-sensitivity and tear-film recovery; PRK/TransPRK remains an important flap-free alternative despite slower epithelial healing. Contemporary comparative evidence does not support choosing a method solely on the basis of a universal superiority claim. The optimal technique should be selected after comprehensive corneal imaging, assessment of refractive stability and ocular-surface health, evaluation of astigmatism, discussion of occupational and lifestyle needs, and informed consideration of each procedure's recovery profile and specific risks.

REFERENCES

1. Wen D., McAlinden C., Flitcroft I., et al. Postoperative efficacy, predictability, safety, and visual quality of laser corneal refractive surgery: a network meta-analysis. *American Journal of Ophthalmology*. 2017;178:65-78. doi:10.1016/j.ajo.2017.03.013.
2. Wei C., Liu J., Zhang C., Liu J.Y., Lu Y.M. Clinical outcomes of SMILE and WFG-LASIK used to treat myopia and astigmatism: a systematic review and meta-analysis. *Journal Français d'Ophtalmologie*. 2024;47(4):104085. doi:10.1016/j.jfo.2024.104085.

3. Tian H., Gao W., Xu C., Wang Y. Clinical outcomes and higher order aberrations of wavefront-guided LASIK versus SMILE for correction of myopia: a systematic review and meta-analysis. *Acta Ophthalmologica*. 2023;101(6):606-618. doi:10.1111/aos.15638.
4. Chen K.Y., Chan H.C., Chan C.M. How effective is keratorefractive lenticule extraction surgery in reducing dry eye outcomes compared to LASIK? A systematic review and meta-analysis. *Journal of Refractive Surgery*. 2025;41(8):e839-e854. doi:10.3928/1081597X-20250506-07.
5. Serfözö A., Abu Dail Y., Munteanu C., et al. The efficacy, safety and predictability in transepithelial photorefractive keratectomy versus LASIK/SMILE: a meta-analysis. *European Journal of Ophthalmology*. 2026;36(4):837-855. doi:10.1177/11206721261425379.