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LASIK, More Recent Advancements, Surgical Developments, Vision Results, and Frontiers Still Uncharted

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Abstract

Background: Refractive surgery has transformed myopia, hyperopia, and astigmatism correction to spectacle and contact lens independence. LASIK is the most common procedure on the planet, yet new technologies are coming into play to deliver optimum precision, security, and quality of vision.

Aim: This is an overview of LASIK and other more recently introduced refractive surgical procedures, such as photorefractive keratectomy (PRK), small-incision lenticule extraction (SMILE), phakic intraocular lenses (IOLs), and refractive lens exchange (RLE) by indication, outcome, benefits, and drawbacks considerations.

Methods: Systematic study of randomized trials, meta-analyses, and influential clinical guidelines have been used in determining efficacy, safety, and long-term outcomes of the different refractive surgery modalities. LASIK is still the gold standard for most refractive abnormalities with rapid visual recovery and high patient satisfaction. PRK is appropriate for thin corneas, while SMILE is appropriate for flapless and less invasive surgery with similar visual outcomes. Phakic IOLs and RLE provide surgically implanted high refractive abnormalities as well as presbyopia.

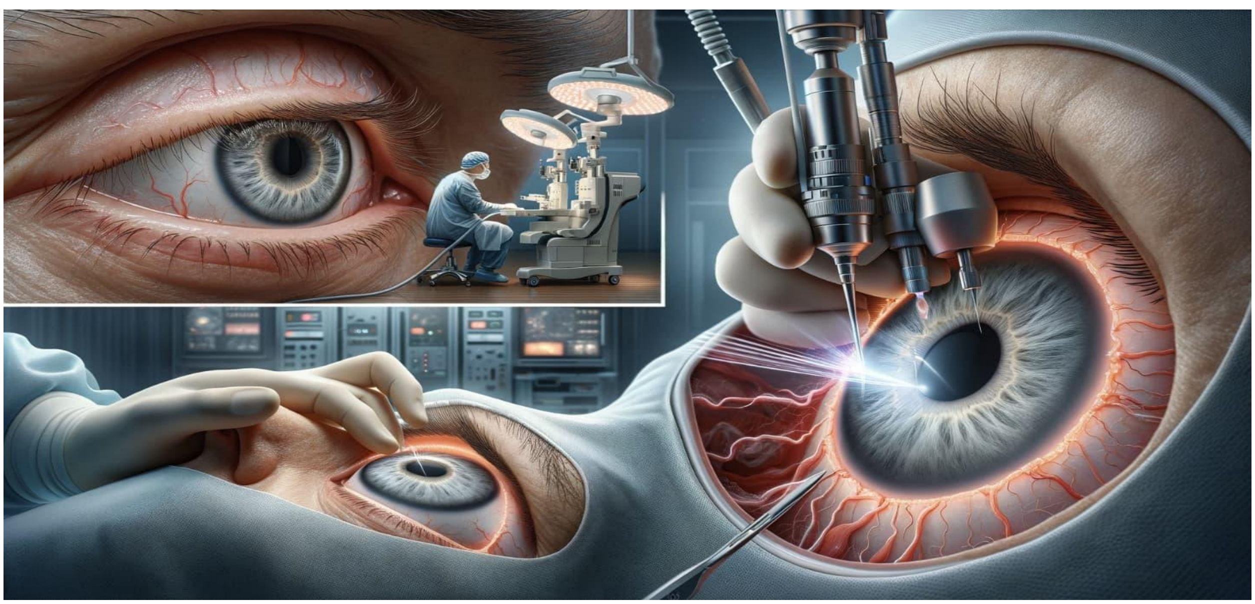
Conclusion: Refractive surgical innovation has optimized treatment modalities, safety, and visual results. Best outcomes demand procedure selectin from patient data and technology data.

Keywords: Refractive surgery, LASIK, PRK, SMILE, phakic IOL, refractive lens exchange, visual results, corneal refractive surgery, surgical innovation.

Introduction

Refractive disorders such as myopia, hyperopia, and astigmatism affect billions of the world population and are the primary sources of preventable visual disability [1]. Glasses and contact lenses have been the cornerstone of refractive management for centuries. Spectacle independence and the progress in lens and laser technology have, however, encouraged the development of refractive surgery as a safe and effective option within the last few decades at a rapid rate [2]. LASIK was the "gold standard" of refractive surgery for over two decades. LASIK is a surgical procedure where a corneal flap is fashioned and excimer laser ablation is utilized to refresh the stromal stroma below and thereby corrects the defect of refraction [3].

LASIK has been associated with early vision rehabilitation, minimal pain, and high patient satisfaction and hence emerged as the most common elective ocular procedure worldwide [4]. Photorefractive keratectomy (PRK) is pre-LASIK surface ablation without flap creation. PRK is post-op pain and more gradual visual recovery but still a choice in thin cornea patients or anatomically or occupationally less well-suited to LASIK [5]. Small-incision lenticule extraction (SMILE) is cutting-edge technology. Femtosecond laser-enabled SMILE extracts a corneal lenticule through a smaller incision without flap creation [6]. It has fewer complaints of dry eyes, improved preservation of the corneal biomechanics, and comparable visual results to LASIK. In very thin, very hyperopic corneas, or presbyopia, RLE or phakic IOLs can be offered [7]. Phakic IOLs will neither be reversible nor eliminate accommodation, but RLE is removal of the indigenous lens and placement of an IOL like cataract surgery [8].



Technological innovations such as wave front-guided ablation, topography-guided individualization, femtosecond laser flap creation, and eye-tracking technology have improved the level of precision and safety during surgery [9]. Preoperative selection of the patient, preoperative examination (corneal tomography and tear film assessment), and postoperative care are milestones to success [10]. The article follows the gamut of refractive surgical procedures, outcomes, and the future and how innovation always extends the horizon of correction of vision.

Methodology

Systematic study from PubMed, Cochrane Library, and Scopus was conducted from 2000 to 2025. The used keywords were "refractive surgery," "LASIK," "PRK," "SMILE," "phakic intraocular lens," and "refractive lens exchange." Clinical guidelines of American Academy of Ophthalmology (AAO) and European Society of Cataract and Refractive Surgeons (ESCRS) were also searched. Inclusion were prospective cohort studies, randomized controlled trials, efficacy, safety, visual outcome, complication, and patient satisfaction meta-analyses with refractive surgery modalities. Study parameters were postoperative visual acuity, predictability, rate of complications, and long-term stability. Adult patients who underwent refractive surgery for the correction of presbyopia, astigmatism, hyperopia, or myopia were included. The evidence was synthesized narratively and in tabular form to facilitate comparison of techniques and pooling of clinical outcomes.

Results

Refractive surgical techniques of refractive surgery are advanced and safer, and procedure choice based on refractive error, corneal topography, age, and patient preference. LASIK is the treatment of choice as it has rapid recovery but alternatives include SMILE and PRK in certain indications. Phakic IOLs and RLE are alternatives in patients who are not candidates for corneal surgery.

Table 1. Refractive Surgical Procedures: Comparison

Procedure	Indications	Visual Rehabilitation	Efficacy (UCVA ≥ 20/25)	Excellences / Advantages	Contraindications / Limitations
LASIK	Myopia, hyperopia, astigmatism	1–2 days	90–95%	Good predictability, fast recovery	Dry eye, flap-related complications
PRK	Thin corneas, myopia	5–7 days	85–90%	No flap, suitable for thin corneas	Painful recovery, slower healing
SMILE	Myopia, astigmatism	3–5 days	88–92%	Biomechanical stability, less dry eye, flapless	Limited correction for hyperopia
Phakic IOL	Thin corneas, high myopia	1–3 days	92–96%	Excellent optical quality, reversible	Risks of intraocular surgery
RLE (Refractive Lens Exchange)	High refractive errors, presbyopia	1–3 weeks	85–90%	Corrects presbyopia, stable result	Loss of accommodation, IOL-related risks

Table 2. Postoperative Results and Complications

Parameter	LASIK	PRK	SMILE	Phakic IOL	RLE
Predictability (±0.50 D)	90–95%	85–90%	88–92%	90–94%	85–90%
Patient Satisfaction	95%	90%	93%	96%	88%
Dry Eye Incidence	High	Moderate	Low	None	None
Major Complications	Rare	Rare	Rare	Rare (risk of cataract)	IOL-related (PCO, glare)

Discussion

Refractive surgery extends with procedure diversification from various patients [11]. LASIK is still the gold standard for refractive irregularities in the majority of patients, with quick recovery, high precision, and tolerable patient tolerance [12]. Its success is augmented with femtosecond laser flap generation, wave front-guided ablation, and real-time eye tracking. Dry eye and postoperative flap complication are still to be overcome [13]. PRK is still a choice, particularly for thin cornea, irregular corneal surface, or for individuals working where flap integrity is highly important. It is similar outcome to LASIK long term but with faster recovery and more postoperative pain [14]. SMILE is flapless and bladeless now. It maintains corneal biomechanics, minimizes dry eye rate, and offers the same refractive accuracy. Its only limitations now are restricted hyperopic correction and learning curve of surgeons. Phakic IOLs offer very good quality of vision to refractive patients for whom laser surgery to the cornea is not suitable due to thinning of the cornea or severe myopia [15]. Phakic IOLs are reversible with accommodation but by intraocular surgery with risk to cataract formation or endothelial cell loss. RLE is generally held in reserve for refractive defects or presbyopia to a considerable degree, and in practice mimics cataract surgery. Security and individualization are the future of refractive surgery [16]. Optics-guided ablation, adaptive optics, intraoperative aberrometry, and artificial intelligence planning are reaching highest predictability [17]. Corneal inlays, variable IOLs, and gene therapy trials are a sign of introduction of new high ametropic and presbyopia treatment. Finally, success is contingent on appropriate patient selection, appropriate preoperative diagnostic workup, and on individually tailored surgical treatment [18]. Expectation counseling and education of worth and potential risk remain of utmost significance in providing patient satisfaction.

Conclusion

Refractive surgery has revolutionized vision correction in that numerous procedures are now available to correct the personalized requirements of the seen patient. LASIK is still the standard by which others are judged in safety and efficacy, but alternatives such as PRK, SMILE, phakic IOLs, and RLE provide options for specific anatomically or refractivity profiled patients. Ongoing technologic advancements further enhance accuracy, safety, and results. Patient selection of the procedure, best preoperative selection, and patient education are the catalyst to maximizing visual outcomes and patient satisfaction with existing refractive surgery.

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