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LASIK, SMILE and PRK: advantages and indications

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LASIK,SMILE 和 PRK 的优势及适应证

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摘要

屈光性角膜切削术(PRK),激光原位角膜磨镶术(LASIK)和小切口微透镜取出术(SMILE)是目前临床上屈光性手术中有效和安全的方法。这三种激光视力矫正方法虽然技术不同,但成功率大致相同。至于哪种方法是最合适的取决于多种因素,包括:屈光度、个人习惯和职业因素(如运动和生活方式)。目前,LASIK 屈光手术应用最广,但 SMILE 也在手术医生间快速推广。后者提高了术后早期的舒适感,还有视力的快速恢复,减少了伤口的愈合反应。此外,与 LASIK 相比,SMILE 术后干眼的发生率较低,因为小切口使前基质损伤小,这意味着前部角膜神经受到影响小。与 LASIK 和 PRK 相比,SMILE 同样可以降低高阶像差(HOA)的形成。术后角膜滞后量(CH)和角膜阻力因子(CRF)与 SMILE、LASIK、PRK 方法无明显差异。但是,PRK 仍然是中度到轻度手术量的最佳选择,特别是涉及薄角膜、频繁角膜侵蚀的病例。

关键词:LASIK; PRK; SMILE

Abstract

• Photorefractive keratectomy (PRK), laser-assisted *in situ* keratomileusis (LASIK) and small-incision lenticule extraction (SMILE) are the most clinically effective and safe techniques, for refractive surgery. All three kinds of laser vision correction, while varying in technique, have roughly a similar high achievement rate. Which method is best for you to rely upon various components like the refractive error, habits and profession, for example, sports and lifestyle. LASIK is as of now the predominant strategy in refractive surgery but SMILE also spreads rapidly between surgeons. This increments comfort amid the early postoperative period, takes into account quick visual recovery, and diminishes the wound healing response. And additionally that there would be less postoperative dry eye after SMILE contrasted with LASIK because the anterior stroma is exasperates just by the small incision, implying that the anterior corneal nerves ought to be less influenced. SMILE likewise lower induction of higher order aberrations (HOA) contrasted with LASIK and PRK. No contrasts between SMILE, LASIK and PRK medicines in postoperative corneal hysteresis (CH) corneal resistance factor (CRF) or corneal hysteresis values. PRK, but, remains a supreme option for moderate to mild modifications, especially for cases involving thin corneas, frequent erosions.

• KEYWORDS:LASIK; PRK; SMILE
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INTRODUCTION

Primary models of excimer lasers utilized wide beams with diaphragms to make small optical regions. Spherical-cylindrical or spherical ablation patterns. Dominant advanced lasers rose utilizing extensive slit beams or scanning systems. More development in lasers happened with the improvement of beam delivery systems related with eye-trackers, the result is complex and difficult algorithms to make slowly aspheric ablations became feasible. For instance, the VISX S3 laser has changeable point scan with a diameter of 6.5-0.65 mm. Also custom corneal ablation, in which there is a connection among the excimer laser and data from the patient's wave front or topography investigation is turning into a reality. Amid the

advancement of surgical process, the way in which excimer laser energy is connected to deformation the cornea has experienced real variations since the presentation of surface ablation; photorefractive keratectomy. Photorefractive keratectomy (PRK) was eclipsed by laser *in situ* keratomileusis. Laser *in situ* keratomileusis (LASIK) quickly became the prevailing refractive method mainly because of the benefits of pull over the central epithelium intact[1] visual restoration in short time with less distress related to LASIK accomplished this technique practical in an expansive number of patients. This has led to the acceptance of LASIK.

It is imperative to say that PRK has dependably stayed as a choice, especially for moderate to low levels of rectification and for particular cases, for example, thin corneas, personal predisposition to contact and injury repeated erosion dependent on with anterior basement membrane dystrophy (ABMD). Regardless, making of the flap is related with the danger of early flap-related complications and post-LASIK dry eyes. The method likewise debilitates the biomechanical quality of the cornea and may prompt late intricacies including postoperative ectasia and regression

Femtosecond Laser The femtosecond laser is defined by ultra-fast pulse within 10-15s. A laser beam is engaged at an exact profundity inside the cornea. At the focus point, short-lived energy bursts convert local tissue into plasma and evaporate a small volume of tissue. This procedure is called photo disruption. Femtosecond laser makes a tissue plane with to a great degree restricted collateral damage[2]. The utilization of femtosecond laser in refractive surgery has gone through different generations[3]. It was first utilized as a part of LASIK flap creation in substitution of microkeratome, offering to ascend to femtosecond laser-assisted LASIK. With advance improvement, stromal ablation is avoided, and instead, an intrastromallenticule is cut and expelled from the cornea. This is known collectively as refractive lenticule extraction. The first to develop was femtosecond lenticule extraction. It included making a corneal flap and an intra stromal lenticule utilizing a femtosecond laser. The lenticule was then extracted after lifting the corneal flap. Thereafter, SMILE was produced in which the lenticule was extricated by means of a small arcuate incision without the requirement for a corneal flap.

Wound Healing Wound healing of the factors fundamentally to the safety and efficacy of keratorefractive surgery. This is a decisive agent over/undercorrections with every laser ablation strategies. Additionally, abnormalities related with wound healing are in charge of side effects, for example, developed lamellar keratitis and haze. The rise of refractive surgery directed the requirement for a superior understanding of corneal wound healing. In this manner, in parallel with the improvements that happened in refractive surgery innovation and tool, there has been a blast in our insight into the molecular and cellular occasions that happen amid corneal healing reaction[4]. The greater part of refractive strategies accomplished on the cornea have damage to the epithelium in like manner. Epithelial damage starts a grouping of occasions that happen as a feature of a defensive system for protecting vision. For instance, keratocyte apoptosis, the main distinguishable occasion after epithelial damage, is related with either mechanical trauma[5] corneal surgical methods[6] or herpetic keratitis, where cell suicide may give an primary fire divider to viral infiltration into the central nervous system (CNS) andeye[7]. Animal examines exhibited that superficial keratocytes experience customized cell demise interceded by cytokines secreted from the harmed epithelium, for example, Fas/Fas-ligand, interleukin (IL)-1 alpha, tumor necrosis factor (TNF) alpha, and bone morphogenic protein (BMP) 2[8].

Excess is most likely expected to increase the characteristic guard system by created it troublesome for viral pathogens to conquer one apoptosis initiation system. These cytokines are also available in the tear film[6]. Keratocyte apoptosis is trailed by a perplexing course of occasions that happens in the corneal epithelium and stoma. These occasions are set by cytokine-mediated associations between epithelial cells, inflammatory cells, stromalcells, nerves, and lacrimal organ[4]. Following keratocyte passing, the rest of the keratocytes encompassing the zone of exhaustion start to experience expansion inside 12-24h of epithelial damage[7]. Now, inflammatory cells are additionally pulled in by chemotactic agent, for example, the monocyte chemotactic and activating factor (MCAF). The monocyte chemotactic and activating factor generation is adjusted in keratocytes by IL-1 alpha. IL-1 is discharged from the epithelium after damage, but at the same time is available in the tear film. It gives off an impression of being an ace modulator of a large number of the occasions engaged with this course[8]. In late Institutional Review Board (IRB) affirmed tests accomplished on eyes from patients planned to experience enucleation on account of intraocular melanoma, it was affirmed that keratocyte apoptosis and proliferation happen in the cornea after epithelial scrape[9]. These occasions happen in parallel with the conclusion of the epithelial flaw, which is improved by development agent created by both the lacrimal glands and keratocytes, for example, keratinocyte growth factor (KGF), hepatocyte growth factor (HGF) and epidermal growth factor (EGF)[10]. Myofibroblasts are keratocyte-derived cells that are available in the repopulated stromata that are portrayed by the outflow of alpha smooth muscle actin (SMA)[10]. Now these cells alongside other enacted keratocytes, deliver confused collagen, glycosaminoglycans and growth factors that invigorate healing of the overlying epithelium[10]. Myofibroblasts likewise have modified transparency *in vivo*, identified with corneal crystallin articulation. They are believed to be in charge of stromal haze[11]. Separation of myofibroblasts is prompted by transforming growth factor (TGF) beta, and inversion to fibroblast phenotype has been seen *in vitro* within the sight of fibroblast growth factor

(FGF)[12]. TGF-beta is presesnt in the basal layer of the epithelium amid its conclusion appears to controls stromal myofibroblast change amid corneal repair[13]. Also, basement membrane formation appears to indirectly affect the myofibroblast change by controlling the degree of TGF-beta discharge into the corneal stroma[14]. There is an arrival to an ordinary physiologic state in the corneal stroma months later after damage. This procedure is related with destruction of myofibroblasts by programmed cell demise or phenotype inversion to quiescent keratocytes[14]. Redesigning of disordered collagen that was delivered by myofibroblasts or actuated keratocytes amid the wound healing procedure is additionally interceded by keratocytes[15]. The corneal epithelium may experience hyperplasia following corneal damage, because of the growth factors created by enacted keratocytes and myofibroblasts[16]. Stromal renovating and epithelial hyperplasia are believed to be the most momentous mechanisms for relapse of the refractive impact of SMILE , PRK or LASIK surgery[17].

Clinical Correlation of Wound Healing Reaction There are essential contrasts in the area and force of the wound healing occasions following PRK, SMILE and LASIK. For instance, after PRK, keratocyte apoptosis and the consequent occasions of the healing course happen instantly underneath the epithelium, presumably causing more effects on epithelial hyperplasia. This appears differently in relation to LASIK, in which keratocyte apoptosis happens at the level of the flap junction and at the place where the blade penetrated the circumferential epithelium[18]. Moreover, there are huge quantitative contrasts in keratocyte apoptosis, keratocyte expansion, and myofibroblast change, among PRK for low myopia and PRK for high myopia, and betwixt PRK for high myopia and LASIK for high myopia[14]. Generally, higher PRK rectification impel more keratocyte apoptosis, keratocyte expansion and myofibroblast change than bring down PRK rectification, and these occasions are less serious in LASIK, notwithstanding for larger amounts of rectification for myopia[14].

These perceptions at the cell level furnish us with a clarification for the distinctions in clinical results and side effects, for example, haze, that happen after LASIK and PRK, and in addition for various levels of rectification[4]. It was normal that there would be less postoperative dry eye after SMILE contrasted with LASIK on the grounds that the anterior stroma is irritated just by the small incision, implying that the anterior corneal nerves ought to be less influenced. Dong *et al*[19] demonstrate SMILE incites less keratocyte apoptosis, expansion and inflammation contrasted and femtosecond laser LASIK. Also Wei *et al*[20] show that the level of cell ultrastructural changes after the SMILE system were bring down contrasted with the PRK procedure. And in study Liu *et al*[21] demonstrated early wound healing reactions and inflammatory after SMILE were negligible. In the preliminary period after surgery, less surgical experience brought about an expanded inflammatory reaction in low myopic corrections. More prominent keratocyte reaction was found in high myopic corrections independent of surgeon encounter.

Riau *et al*[22] shown that the ReLEx technique may outcome less topographic changes, inflammation, and early extracellular lattice deposition than LASIK, particularly at high refractive correction.

Ocular Surface Dry eye is a typical grumbling between patients who have experienced refractive surgeries, incorporating LASIK, PRK, SMILE and femtosecond LASIK (femto-LASIK), and the occurrence of dry eye changes between these patients. Murakami *et al*[23] demonstrated significant contrasts amongst LASIK and PRK were clear just in the main first month for visual vacillation, yet not for dry eye or foreign body sensation. There were no impacts of age, central ablation profundity, or flap thickness on patient-reported visual variance, dry eye, and foreign body sensation. SMILE is a new method that can be utilized in the surgical rectification of myopia that no need to created corneal flap. This method makes it workable for SMILE patients to have brought down dangers of advancement of dry eye and diminished corneal sensation after the operation. Ganesh *et al*[24] shows that SMILE surgery can causes symptoms of dry eye, instability of tear film, and decreased corneal sensitivity. In addition, SMILE has predominance over femto-LASIK in bring down danger of postoperative corneal fluorescein recoloring and less diminishment of corneal sensation. The SMILE methodology has a less articulated effect on the ocular surface and corneal innervation contrasted and LASIK, additionally decreasing the rate of dry eye and ensuing corruption in personal satisfaction after refractive surgery[25].

Efficacy, Safety and Visual Performance SMILE efficiency is defined as the percentage of eyes with excellent postoperative uncorrected distant visual acuity (UDVA)[26]. The first SMILE study, 62% of eyes accomplished UDVA $\geqslant$ 20/20, while 93% accomplished $\geqslant$ 20/40[26]. The relating percentages for LASIK were 95% and 71%. In an examination contrasting SMILE and LASIK for 111 eyes, the two cohorts did not vary essentially in percentage of eyes with a UDVA of 20/20 or better at 1 and 3mo[27]. Also, spherical aberrations and HOA were essentially lower in the SMILE cohort[27]. from the aspect of safety, most patients can adjust the corrected visual acuity (CDVA) to the safety index (defined as CDVA CDVA before surgery) between 1.0 and 1.1[28]. Reduce two or more lines was noted in just 0%-2.3% of SMILE patients, contrasted and 0%-2.4% for LASIK. Spherical aberrations and High order aberrations were less common following SMILE than LASIK[29]. This was proposed to be identified with the absence of flap creation in SMILE, and additionally a more good healing reaction with femtosecond laser than with excimer laser. With SMILE, an anticipated correction in refractive result can be accomplished. 79% to 92% of patients accomplished within ± 0.5 D of target refraction, contrasted with 80 with 90% for LASIK. For the two systems, >90%

subjects could accomplish inside ±1.0 D of target refraction[26]. Refractive result was steady in long-term follow-up. More than 5y, a regression of 0.48 D was noted in SMILE patients, contrasted and 0.63-0.97 D in LASIK patients[30]. It has been suggested that SMILE reduces the symptoms of dry eye by saving corneal sensation without flap creation. Proof recommends that SMILE is related with less denervation, quickened healing of the ocular surface, and better corneal affectability[31]. Higher rates of LASIK than SMILE patients are accounted for to have moderate to mild dry eyes a half year postoperatively[25]. Biomechanical strength is hypothesized to be stronger with SMILE, attributable to protection of the anterior corneal stroma. Mathematical modelling proposes that stromal rigidity ought to be stronger with SMILE than LASIK[32]. In any case, clinical outcomes measured with Ocular Response Analyzer or CorVisST stay questionable[32-33]. A biomechanically stronger cornea ought to convert into danger of ectasia and less regression in the long-term, albeit no such long-term information is accessible for SMILE yet. A Meta-examination of 11 comparative studies involving 1101 eyes gives more understanding into the adequacy efficacy and safety of SMILE in correlation with FS-LASIK[34]. The two methods did not contrast significantly in the mean postoperative refractive standard error, extent of eyes losing at least one lines of CDVA, extent of eyes accomplishing UDVA 20/20 or better, or extent of eyes with postoperative refractions inside ±1.0 D of the target. At a half year postoperatively, the SMILE group had significantly higher corneal affectability and longer tear break-up time. These outcomes were in line with the impression got from the discoveries of individual examinations that SMILE and FS-LASIK were practically identical as far as safety and efficacy, with SMILE conceivably unrivaled in lessening dry eye side effects. We have additionally announced practically identical safety and efficacy with SMILE[35]. For efficacy, UDVA was 20/20 or better in 48%-80% of all subjects, and 20/40 or better in 93%-100%. For safety, no patient had lost at least two lines of CDVA, and 93%-99% had no loss of CDVA. For consistency, 94% accomplished inside ±1.0 D of target refraction. Correction of astigmatism in SMILE was often inadequate[35]. Our information demonstrated that 87%-96% of all subjects had correction of astigmatism inside ±0.5 D. Utilizing vector analysis, we measured an correction index of astigmatism by contrasting surgical and target-induced astigmatism. The index was 0.94-1.03 for LASIK and 0.81-1.00 for SMILE, proposing satisfactory correction of astigmatism for the two strategies[36]. As far as biomechanical steadiness, our experience recommends less lessening in corneal hysteresis, corneal resistance factor in SMIL[33]. The most common side effects of SMILE, in descending order, were peripheral corneal abrasion (5.5%), corneal haze (5.4%), lenticule extraction difficulties (1.5%), early dry eye (3.2%), suction loss (1.0%), tear at incision edge (1.5%), irregular topography (0.5%), epithelial in growth (0.5%), keratitis (0.3%), and corneal microstriae (0.4%). Both PRK and SMILE were effective techniques for correction of low myopia. Anyway, SMILE offered superior patient satisfaction and quality of vision due to lower induction of aberrations at 3mo and better postoperative comfort[37]. Intrastromal flapless process had less effect on anterior stromal collagen mechanics and outcomes of less stromal bed replacements and stresses than flap-based process in contralateral eyes[38]. Also, biomechanical affect changed broadly amongst individuals and this fortifies the requirement for individualized appraisal of ectasia hazard[38]. Topographic epithelial rebuilding designs contrast following SMILE or FS-LASIK. Epithelial renovating seems to more consolidation quickly following SMILE than FS-LASIK[39]. Both SMILE and WFG FS-LASIK can accomplish arranged visual results in correcting myopic astigmatism and myopia. Also, higher vertical coma was appeared in SMILE than WFG FS-LASIK which may be a possibly affect agent for patients' vision under specific lighting situations and requirements advance examination[40]. In study comparison of visual outcomes and HOA after, SMILE is a safe and effective surgery for correcting myopia. However, the objective correction amount in high myopia patients ought to be acclimated to dodge under correction and gained more satisfaction. SMILE incited increments of HOAs[41]. No contrasts between SMILE, lasik and PRK treatments in postoperativecorneal resistance factor or corneal hysteresis values[42]. Measurement of corneal clearness utilizing the Scheimpflug CD demonstrated comparable outcomes previously and 3mo after SMILE. Contrasted with FS-LASIK, no significant differences of corneal clearness and CDVA were discovered 3mo postoperatively[43]. WFG LASIK and SMILE are safe and effectual methodology for the adjustment of low and moderate myopia, however WFG LASIK permits a more predictable result and better aberrometric control[44]. Topography-guided LASIK was preferable in all visual efficiency parameters studied, objective and subjective[45]. The principal difference among the two methods is probably from the eye tracking, cyclorotation recovery, and active centration control in the LASIK technology studied in contrast to the present innovation accessible with SMILE-like techniques. This distinction seems to influence refractive and visual aberration execution results[46]. Contrast with FS-LASIK, dry eye and the corneal affectability recuperate better in the SMILE gathering, in first three months after the surgery[46]. As indicated by this meta-analysis, the SMILE system has less negative effects on the ocular surface and corneal innervation than does FS-LASIK. Moreover, SMILE demonstrates prevalence over FS-LASIK by a showing a lower danger of postoperative dry eye[47]. LASEK, SMILE, and LASEK-CXL surgery have all the earmarks of being effective and safe for high-degree myopic rectification. But, the SMILE group had no haze and less acceptance of some HOAs contrasted with the LASEK-CXL and LASEK groups[48]. Though further follow-up and bigger examples are

expected to completely affirm these discoveries, the outcomes recommend that SMILE and intrastromal corneal collagen crosslinking are a promising treatment choice for patients for whom ordinary laser refractive surgery is contraindicated[49].

Corneal Hysteresis and Corneal Resistance Factor Distinctive refractive surgeries (LASIK, PRK, femtosecond LASIK, laser-helped subepithelial keratectomy and SMILE) outcome in modifications in corneal biomechanical parameters owing to stromal expulsion or removal with subsequently diminished CH and CRF[50]. CRF and CH are Biomechanical Properties of the Cornea, which demonstrates the corneal viscoelastic attributes[51]. Previous examinations assessed CRF and CH after PRK and LASIK[50]. As the biomechanical attributes of the cornea (CRF and CH) are related with age and numerous investigations presumed that the CH is connected with the CCT[52].

Wang *et al*[53] and Wu *et al*[54] CH and CRF values were compared before and after SMILE and femtosecond LASIK at different levels of myopia. They did not find a significant difference in the two groups in myopic less than -6.00 D. But, in the eyes with a nearsightedness of more than -6 D, CRF and CH in LASIK significantly more reduce than SMILE cases.

Risk Factor Ectasia It is believed that SMILE has a biomechanical effect on corneal integrity less than PRK and LASIK[55]. Tissue evacuation in SMILE happens considerably more deeper than in PRK and LASIK staying away from the intrusion of the strong joining, steeper angles, and sheer worry of the foremost stroma[56]. In particular, SMILE is thought to outcome in more prominent stromal collagen solidness and less mishappenings in the residual stromal bed (RSB) when contrasted with LASIK and PRK[57]. In spite of the fact that the hypothetical danger of ectasia might be lessened, it isn't totally disposed of because of the interruption of stroma that takes after any corneal refractive surgery[58]. In study Moshirfar *et al*[59] that four cases portrayed, pre-surgical anomalous topography was noted in three subjects with post-SMILE ectasia. Ectasia happened not long after a medical procedure in these patients. This recommends SMILE may not be appropriate for patients showing subclinical keratoconus, like LASIK. One case announced ectasia with ordinary pre-surgical topography, meaning that unusual topography may not be the main hazard factor for creating ectasia after SMILE. An RSB of 300 μm is believed to be a hazard factor for ectasia after LASIK[59]. However this guideline has been connected to SMILE, experts as of now don't comprehend what the safety limit for RSB ought to be. It has been conjectured that leaving a more slender RSB might be a feasible parameter for accomplishing higher nearsighted redress in SMILE. Experts who perceive the enhanced biomechanics of SMILE have proposed extricating a more profound lenticule and leaving a lower safety limit RSB given the safeguarded respectability of the more grounded front stroma[61]. For instance, an RSB of 220 μm might be feasible with preservationist estimations utilizing a CT of 120 μm, involving a corneal epithelium of 40 μm and a front stroma of 80 μm. This would outcome in a hypothetically unaltered stromal tissue of 380 μm if the rigidity of 80 μm of the foremost stroma is viewed as proportional to that of 160 μm of back stroma[61]. This speculation may not remain constant given that patients in this survey created ectasia in spite of having an RSB of 300 μm.

Managing of Ectasia PRK and LASIK have been perceived as debilitating the corneal auxiliary respectability by 14%-33% and may expand the danger of ectasia[62]. To solve this issue, adjuvant techniques utilizing collagen cross-linking (CXL) at the season of laser refractive surgery have been recommended. For prophylactic aim, practically any corneal excimer laser patient can be remedy with cross-linking, albeit certain powerless patients may profit more[63].

Regardless of that, the visual outcome and the topography of patients treated with only CXL demonstrate no change or only an insignificant change due to leftover irregular astigmatism. Excimer laser surgery in the form of non-topo-guided photorefractive keratectomy (non-T-PRK) and topo-guided photorefractive keratectomy (T-PRK) beside reduction of irregular astigmatism, regulate shape of the cornea to improve visual outcoms[64]. The combination of CXL and excimer laser PRK is the new upcoming treatment for mild to moderate keratoconus[64]. However, no confirming evidence exits so far concerning the potential benefits of the T-PRK method over the standard, non-T-PRK one.

The mixture of both LASIK and PRK with CXL has come into work on showing good results[63] along these lines expanding the incorporation criteria for potential patients who were at first ineligible for excimer laser correction. Proceeding with the arrangement, we proceeded advance ahead with new methodology SMILE Xtra, which contain simultaneous high fluence cross-linking of cornea following ReLEx SMILE for myopia, in individuals who might be in danger of future corneal ectasia. The idea is like the examination by Wu *et al*[64] who did CXL in a femtosecond laser made a corneal pocket in early keratoconus, proposing an effective and safe option in contrast to regular CXL with advantages of no profound it dithering, quicker healing, and decreased odds of contaminations and patient comfort is better[65]. An ongoing report consolidated accelerated cross-linking with ReLEx SMILE in early keratoconus eyes, and one year follow up proposed this a promising methodology in capturing ectasia[64]. Maybe the mix of small-incision lenticule extraction and intrastromal CXL can good be contrasted and the technique utilized in the Athens convention, distributed by Kanellopoulos *et al*[63]. In that convention, the creators consolidated PRK and epi-off CXL. According to study Graue-Hernandez *et al*[49] that named technique the AZTEC convention. Nonetheless, several discrepancies should be considered. The Athens convention is gone for treating progressed keratoconic malady with topography-guided

ablation, which hypothetically redistributes corneal strain through stromal rebuilding. Its objective is in this way to enhance CDVA. Then again, the Aztec convention expects to accomplish spectacle freedom in patients with early keratoconus, in whom visual exhibition rectification is as yet agreeable yet wearing spectacle or contact lenses is deplorable. Being a sub-Bowman system, additionally debilitating is less inclined to happen than with PRK; moreover, since the epithelium has not been evacuated, pain and risk of infection are much diminished. At long last, there is some worry that crosslinking may reason progressive flattening with time. Graue-Hernandez *et al*[49] demonstrated, the Aztec convention is by all accounts an effective, unsurprising, and stable methods for treating early keratoconus, giving spectacle freedom and conceivably enhancing biomechanical dependability, and this was not significant over the two year follow-up period, which could be represented by the diminished impact with intrastromal CXL, despite the fact that, as expressed prior, it might, in any case, be sufficient to accomplish stability[65].

Indications and Contraindications: SMILE, LASIK and PRK

SMILE SMILE is proper for most patients who are fit for refractive corneal surgeries. Its utilization in correcting myopia and myopic astigmatism has been set up[62]. In light of our experience, the ideal range of spherical and cylinder is -0.75 D to - 10 D and <-5 D, respectively. Keratometry should fall in side 38-48 D. However, its application to correct hypermetropia is still under consideration. Other criteria include age 18 or older, stable refraction, transparent cornea with no history of scar or keratitis, corneal thickness > 480 μm and normal topography. SMILE is contraindicated in those with previous intraocular surgery, autoimmune connective tissue disorders or ocular co-morbidities. Many refractive surgeons experienced with LASIK may waver to change to SMILE because of the expectation to learning curve. We talk about a few common intraoperative challenges and give some administration tips. Maintaining centration. Without legitimate centration, the precision of laser-based incisions is compromised. To accomplish better centration amid docking, the patient should be instructed to keep fixating on the light until suction is applied. Patients with more extreme astigmatism or a bigger angle Kappa may require promote adjustment. Negative suction keeps up the eye position once centration is accomplished. A lower suction enables the patient to focus on the light all through the system. The size of the suction ring depends on the base refractive error and the size of the globe. Generally, a small ring size is suggested for myopia correction in Chinese, while a medium ring size can be utilized for astigmatism correction. The connecting tubes must be in placed at patient's temporal side suction loss may happen notwithstanding when suction is properly accomplished in the first instance. To keep this, the surgeon ought to abstain from putting the conjunctiva under suction. Conjunctival discharge and extra liquid ought to be wiped away in time, and environmental interactions are minimized. In the event of instability, the surgeon must re-apply suction. If loss of suction happens, the surgeon can choose to continue to SMILE, turn to LASIK or FLEX, or re-change the operation.

LASIK LASIK is the most popular and common refractive surgery. The most important benefits of LASIK are as follows: 1) Rapid visual rehabilitation with early after surgery consolidation of visual acuity; 2) More comfort after surgery; 3) Less stromal haze formation and attenuated wound healing; 4) Possibly amended predictability, corneal clarity, and stability in higher correction groups; 5) After surgery, less time is spent on medications; 6) It will improve sooner; 7) Range: -2 to -10 D with up to 6 D astigmatism.

Maybe at no other time has an ophthalmic strategy got such a great amount of consideration without information seeing efficacy or safety as LASIK in its initial days. As LASIK increased, several new complications were created: 1) LASIK unexpected neurotrophic epitheliopathy (LNE); 2) Possibility to create diffuse lamellar keratitis (DLK); 3) Possibility to create lamellar opportunistic infections; 4) Possibility to create keratectasia.

The femtosecond laser helpful in creating a slim flap with unmixed thickness with insignificant presentation of epithelial cytokines and debris into the interface. A few points of interest in the injury mending can be envisioned. This method also has the ability to almost eliminate the side effects caused by the formation of a flap. Furthermore, a thin flap would leave more tissue accessible for the refractive ablation, limiting the danger of keratectasia.

PRK PRK remainder a choice to LASIK and in some situations is the favored method. *e.g*: 1) The benefits of PRKs may be a better option Choosing a patient; 2) Inclination for contact damage; 3) Cogan's dystrophy; 4) Epithelial sloughing amid LASIK in the contralateral eye stroma residual is less than 250-300 microns in the thin cornea tight eyelid fissure or deep orbits causing poor exposure for lasik steep corneas (>48D) or flat corneas (<41D); 5) Past surgery including the conjunctiva: bleb related with filtering process; scleral buckle used for retinal detachment (RD), moderate dry eye before operation.

Late onset corneal haze is an imperative side effect of PRK[3]. In the author's experience of more than 3500 PRK process there has not been a one case of late haze[3]. It has been resolved over time, but in severe cases it may take several years. Epithelial debridement is related with recurrence[3]. Treatment with Mitomycin C might be useful in extreme cases[4]. We assume that this kind of extreme haze is related with an underlying hereditary issue in wound healing. This is haze that happens following three months, the time when ordinary postoperative haze is abating, and may agree with the with drawl of topical steroid.

Table 1 Summary comparison methods

Parameters	PRK	LASIK	SMILE
Methods	Surface removal of corneal	Flap surgery, folding away the top corneal layer and reshape tissue below	Minimally invasive surgery, extraction of lenticule
Advantages	Choice for thinner corneas or other cornea situation	High rate of understanding, generally accessible	Keyhole methodology, keep structure of the front corneal tissue
Complications	Longer visual recuperation, less patient comfort amid recuperation	Feasible flap relevant complications	Some complications need changing to LASIK
Eligibility, safety, efficacy			
Nearsightedness	OK	OK	OK
Farsightedness	OK	OK	Currently in clinical trials
Astigmatism	OK	OK	OK
Surgery			
Access to the cornea	Removal of the epithelium by an alcohol	Flapcreated by a hand held device (microkeratome) laser or a femtosecond with a circumferential incision of nearly 20 mm	Small incision up to 4 mm created by a femtosecond laser
Shaping the cornea	Laser removes tissue by multiple-pulse photoablation	Laser removes tissue by multiple-pulse photoablation	Laser creates a thin lenticule inside the cornea
Completing the process	PRK-Bandage contact lens inserted	Flap placed back to its position	Laser creates incision Surgeon removes the lenticule through the incision
Recovery			
Bandage	Bandage contact lens is worn for about 4d after surgery	Sleeping patch for the first few days after surgery	Sleeping patch for the first few days after surgery
Healing	Eye may feel somewhat coarse and cause distress for one week after surgery. Visual recuperation could take over a month	Vision might be blurred for a few hours and there might be a burning sensation for the first day after surgery. Vision may take a few of days to become stead	Eye may feel somewhat bothered for the first couple of days after surgery. Typically the eye recovers rapidly after surgery. Vision can enhance quickly however may likewise take a couple of days
Activity restrictions	Control for approx. One month from outdoor and strenuous exercises	Refrain for approx. One month from outdoor and strenuous exercises	Limit for approx. Three days from outdoor and strenuous exercises
Technical Information lasers used	Only an excimer laser	Microkeratome or femtosecond laser for flap creation; excimer laser for tissue ablation	Only a single femtosecond laser

In conclusion, PRK, LASIK, and SMILE are the most clinically effective and safe techniques, for refractive surgery. The three sorts of laser vision correction, while contrasting in technique, have almost a similar high success rate. SMILE has great efficacy and safety comparable with LASIK and PRK. As a flapless process, it protects more corneal sensation than LASIK and outcomes in less postoperative dry eyes. It additionally has biomechanical advantages (Table 1).

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