

## Guidelines and Clinical Pearls for Laser Vision Correction

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### Abstract

LASIK and PRK are well established procedures for the correction of myopia, hyperopia, and astigmatism. The percentage of ophthalmologists and optometrists that have undergone these procedures is higher than in the general population.

The clinical goal is to continue to advance the technology and techniques to improve outcomes. The newest and considered the most advanced custom vision correction is Topography-guided LASIK and Topography-guided PRK using advanced analytics software. Topographic corneal imaging is used to measure over 20,000 data points, and this curvature information is used to guide the excimer laser to reduce irregularity of the corneal surface and treat the refractive error. In addition, the excimer laser ablation is centered on the line of sight versus the center of the pupil, and there is iris registration to account for cyclotorsion.

Outcomes have shown a 98% chance of achieving 20/20 or better. This is the best outcomes ever reported in the peer-review literature in the field of refractive surgery. A prospective randomized trial is underway to confirm the encouraging results. We are at a stage in laser vision correction that patients can achieve improved vision quality over glasses and contact lenses.

Ophthalmologists, optometrists, and allied-health personnel involved in patient counselling in refractive surgery, need to stay current with the latest information on patient selection to continue to achieve the best outcomes.

This course covers important guidelines and clinical pearls for Laser Vision Correction based on the scientific literature and 30 years of clinical experience.

### Refractive Parameters:







Understanding the refractive limitations of excimer laser treatments allow for enhanced outcomes and minimizes the risks of complications such as induced high-order aberrations and regression. Laser vision correction should be delayed until 18 years of age or older so patients can give informed consent for the procedure. There are limitations to the amount of correction for myopia, hyperopia, and astigmatism, as well as to how steep or how flat a cornea can be altered and still maintain quality of vision. The surgical goal is to overcome the physiological corneal healing response to create and maintain a new corneal shape. Over the years, advances in excimer laser technology with flying spot lasers and large optical and transition zones have allowed for more precise and stable refractive outcomes. (See Table 1)

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Table 1		
FINDINGS	COMMENTS	INDICATION
Stable Refractive Error <sup>1,2</sup>	Exception are patients pursuing a career that require a level of uncorrected vision, such as police force, firefighter, or pilot. Higher risk of enhancement.	
Myopia < 10.0 D <sup>1,2</sup>	If higher RX or lower RX with thin cornea, consider Implantable Contact Lens (ICL) if anterior chamber (AC) ≥ 2.8 mm, or Refractive Lens Exchange (RLE) if presbyopic and not interested in ICL with monovision. In high myopia with an axial length > 25 mm, there is a higher risk of retinal tears and retinal detachment with RLE compared to ICL.	
Predicted post-op cornea ≥ 32 D <sup>1,2</sup>	If predicted post-op cornea < 32 D, consider myopic ICL if AC depth ≥ to 2.8 mm, or RLE if presbyopic.	
Hyperopia < 5.0 D <sup>1,2</sup>	If higher Rx, or steep preop cornea, to consider ICL if AC > or = 3.0 mm, or RLE if presbyopic.	
Predicted postop cornea < 50 D <sup>1,2</sup>	Too steep a cornea results in a rapid tear breakup and dry eye symptoms. Consider hyperopic ICL if predicted postop cornea = or > 50 D, if AC depth > or = to 3.0 mm, or RLE if presbyopic.	
Astigmatism = or < 6 D <sup>1,2</sup>	Custom TG-LASIK and TG-PRK allows for iris registration to compensate for cyclotorsion. This custom technology can improve results especially for higher degrees of cylinder.	

### Other Eye Findings:

Patient selection can be altered by abnormalities or normal variations of the lids, cornea, iris, pupil, lens, retina, and optic nerve. The age of the patient and their lifestyle goals can influence the type of refractive procedure. (See Table 2)

Table 2		
FINDINGS	COMMENTS	INDICATION
Presbyopia <sup>3</sup>	The best candidates for monovision LASIK or PRK are patients that have done well with monovision contact lenses. If patients are ok with a pair of readers, then laser surgery can provide best distance vision. To consider RLE if there are any significant lenticular changes, or if patients prefer a multifocal or extended-depth of focus implant to provide distance and near with both eyes.	
Contact lens wear: soft or hard lenses <sup>4</sup>	Candidate for either LASIK or PRK. Important to have refractive and topographic stability, which is usually achieved after 5 days of discontinuing soft contact lenses and one month with rigid gas permeable lenses. This can vary with hard lenses up to 6 months or in cases of orthokeratology up to one year.	
Recurrent Corneal Erosions <sup>5</sup>	Preferred procedure is PRK, which roughens Bowman's layer to promote epithelial adhesions and decrease corneal erosions.	
Nystagmus <sup>1,2</sup>	Candidate for PRK or LASIK. Tracking systems can compensate for eye movements and/or surgeon can stabilize the eye with a fixation device.	
Amblyopia or Monocular Patients <sup>6</sup>	Patients can have LASIK or PRK but need to understand the increased risks with only one functional eye.	
Keratoconus, Pellucid Marginal Degeneration <sup>7</sup>	Consider Corneal Crosslinking (CXL) and Topography-guided PRK (TG- PRK) to stabilize and improve vision. LASIK is contraindicated because of risk of further ectasia.	
Thin Cornea < 480 microns <sup>8</sup>	Rule-out Keratoconus using computerized tomography to evaluate both the anterior and posterior cornea. If there is no evidence of keratoconus and a low refractive error, to consider PRK. If the refractive error is high, to consider ICL, or RLE in a presbyope.	

 = YES     = USE CAUTION     = NO

Table 2 continued		
FINDINGS	COMMENTS	INDICATION
Pupils > 8 mm <sup>9</sup>	Clinical studies show no increased risk of halos. Nevertheless, patients with very large pupils should be warned of the potential for halos at night.	?
Dry Eyes <sup>1,2</sup>	Relative contraindication. If dry eye with corneal involvement (SPK), this needs to be resolved prior to surgery. May have aqueous deficiency or meibomian gland dysfunction. LASIK or PRK have not been shown to induce a dry eye in the long-term.	?
Blepharitis <sup>1,2</sup>	Inflammation of lids results in an increased risk of a corneal ulcer or infiltrate. Treatment is necessary to optimize the lid margins. This may include antibiotic and/or steroid drops, lid wipes, and compresses.	?
Epithelial Basement Membrane Dystrophy (EBMD) <sup>10</sup>	If EBMD is present centrally and there is astigmatism > or = to 0.75 D, then consider superficial keratectomy followed by PRK when refraction and topography are stable. Higher risk of epithelial defects with LASIK.	?
Salzmann's Nodular Degeneration <sup>10</sup>	If there is reduced best-corrected acuity or induced astigmatism secondary to Salzmann's nodules, then a superficial keratectomy should be performed. Following a keratectomy, when refractive and topographic stability are achieved, then LASIK or PRK can be performed.	?
Corneal Scarring <sup>1,2</sup>	If satisfactory corneal thickness, and scarring does not interfere with best-corrected acuity, then LASIK or PRK can be performed. If there is reduced best-acuity secondary to irregular astigmatism or because of the opacity, then TG-PRK can be performed. Removal of the scar tissue depends on the scar depth, thickness, location, and amount of ablation guided by the refractive error.	?
High Angle Kappa (difference between center of pupil and line of sight) <sup>11</sup>	A standard excimer ablation is centered over the pupil. In patients with a high angle kappa, it is preferred to use a custom ablation to allow centration over the line of sight.	?
Inflammatory Eye Disease such as Iritis or Uveitis <sup>12</sup>	Important to have inflammation under control with a quiet period of one year prior to laser vision correction.	?
Herpes Simplex Corneal Disease <sup>13</sup>	Needs to be inactive for at least 1.5 years. Surgery contraindicated if reduced best-corrected spectacle acuity (BCSVA) secondary to corneal scarring. If excellent BCSVA, then surgery can be considered with the use of Acyclovir pre-op and post-op to decrease chance of recurrence.	?
Fuchs Corneal Dystrophy <sup>14</sup>	A corneal endothelial dystrophy can lead to reduced vision secondary to corneal edema and require an endothelial transplant (DSEK or DMEK). Most patients with corneal guttata never require a transplant. If the patient has excellent best-corrected acuity, a clear cornea, and a corneal thickness of less than 600 microns, then the long-term prognosis with LASIK or PRK is excellent. All patients need to be counselled about the risk of corneal edema.	?
Night vision issues or reduced quality of vision secondary to higher-order aberrations <sup>15</sup>	Topography-guided LASIK or Topography-guided PRK can be performed using analytic software to improve quality of vision and uncorrected visual acuity.	?
Lattice degeneration and/or retinal holes <sup>16</sup>	Patients are at higher risk of a retinal detachment with or without surgery. Consideration can be given to PRK over LASIK because of less pressure on the eye and theoretically a lower chance of a posterior vitreous detachment resulting in a retinal tear. Nevertheless, in a 10-year study of over 20,000 nearsighted patients, LASIK did not increase the overall risk of retinal detachment.	?

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Table 2 continued		
FINDINGS	COMMENTS	INDICATION
Orthokeratology <sup>17</sup>	Gas permeable contact lenses worn at night can reduce myopia by flattening the cornea. This is achieved by thinning corneal epithelial cells centrally and thickening in the midperipheral. Significant corneal instability results when the contact lenses are discontinued. Patients may undergo LASIK or PRK when the refractive error and topography become stable, which may take up to a year.	?
Prisms in Glasses <sup>1,2</sup>	Prisms in glasses are typically given to treat double vision from eye misalignment. Underlying issues may be an eye muscle problem such as strabismus, or nerve-related issues. Patients can have laser vision correction to reduce the thickness of their glasses, but glasses with prisms will still be required.	?
Glaucoma <sup>18</sup>	If normal visual field and IOP under control this is a relative contraindication. IOP must be carefully monitored postop especially with use of topical steroids and a thinner cornea that can artificially create a lower intraocular pressure. Patients with advanced glaucoma with field loss should not undergo laser vision correction.	?
Lagophthalmos <sup>12</sup>	Poor lid closure can be secondary to thyroid eye disease, Bell's palsy, eyelid surgery with excessive tissue removal, floppy eyelid syndrome, and other conditions. Lagophthalmos is a contraindication to surgery as this can lead to a displaced flap or poor epithelial healing in PRK.	X
Cataracts that Interfere with visual acuity or quality of vision <sup>1,2</sup>	Cataract surgery is indicated. An increase in myopia is a common finding with nuclear cataracts. Detection of significant intraocular higher-order aberrations can be the first sign of an early cataract.	X
Chalazion <sup>19</sup>	A large-size chalazion, especially of the upper lid can induce astigmatism and induction of higher-order aberrations. It is important to have resolution of the chalazion prior to LASIK or PRK.	X

### Prior Ocular Surgery:

The type of previous eye surgery influences the decision on the type of refractive surgery. Complications can occur if the incorrect procedure is chosen. Clinicians should understand the risks in different scenarios and counsel patients accordingly. (See Table 3)

Table 3		
FINDINGS	COMMENTS	INDICATION
LASIK <sup>20</sup>	LASIK enhancement typically up to 12 months. Lifting a LASIK flap after 12 months increases the risk of epithelial ingrowth, especially if a mechanical microkeratome was used versus a femtosecond laser. If greater than 12 months, to consider PRK if satisfactory corneal thickness and no evidence of ectasia.	✓
PRK <sup>21</sup>	If corneal thickness is satisfactory and there is no evidence of ectasia, then a PRK enhancement can be performed. The other option is a primary LASIK procedure, if the predicted residual stromal tissue beneath the flap is > 280 microns.	✓
Pseudophakia (previous cataract or refractive lens exchange) <sup>22,23</sup>	Both LASIK and PRK are options. Other consideration is a secondary piggyback IOL in the sulcus or an ICL. Glare and halos in a patient with a multifocal or extended-depth of focus implant, can be reduced by the correction of a residual refractive error.	✓
Implantable Contact Lens (ICL) <sup>24</sup>	Both LASIK and PRK are options. If there is residual astigmatism, consideration can be given to rotation of the ICL. Wavefront analysis that measures both the anterior corneal astigmatism and intraocular astigmatism, can allow for surgical planning on the required degrees and direction of rotation of a misaligned ICL.	✓
Radial keratotomy <sup>25,26</sup>	If hyperopic, to consider PRK, ICL if AC depth $\geq$ 3.0 mm, or RLE if presbyopic. If myopic, to consider PRK, ICL if AC depth $\geq$ 2.8 mm, or RLE if presbyopic. LASIK is contraindicated. Important to understand that postop results can be unstable if there is further flattening from the RK incisions and a hyperopic shift.	?

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Table 3 continued		
FINDINGS	COMMENTS	INDICATION
Previous laser vision correction and night vision issues or reduced quality of vision secondary to higher-order aberrations <sup>27,28</sup>	Topography-guided PRK can be performed to improve both quality of vision and uncorrected visual acuity. Small optical zones can be enlarged, a decentered ablation can be corrected, and any surface irregularity can be reduced. It is important to rule out any lenticular changes as the main cause of the reduced quality of vision.	?
Corneal graft <sup>29</sup>	Safer to proceed with PRK so as not to cut through the graft-host junction creating wound instability and induction of irregular astigmatism.	?
Retinal detachment <sup>30</sup>	If satisfactory vision following retinal detachment repair, patient can have either LASIK or PRK. If the scleral buckle is anterior, and/or there is scarring of the conjunctiva, these factors may interfere with achieving satisfactory suction for the LASIK flap.	?

### Systemic Condition:




A complete history is taken to identify systemic conditions, as some conditions can affect the outcomes and healing response. (See Table 4)

Table 4		
FINDINGS	COMMENTS	INDICATION
Dermatologic Keloids <sup>31</sup>	There is no evidence of an increased risk of corneal haze or scarring with a history of skin keloid formation. Candidate for LASIK or PRK.	✓
HIV infection <sup>32</sup>	There are no studies on the efficacy and safety of performing laser surgery on patients with HIV. Patients may be candidates for LASIK or PRK, provided there are no acute ocular complications from HIV and the patient is on systemic treatment. Extra operative precautions should be taken by the surgeon and staff.	✓
Collagen Vascular Disease (CVD): Rheumatoid Arthritis, Systemic Lupus, Scleroderma, Dermatomyositis, Ankylosing Spondylitis, Psoriatic Arthritis <sup>33,34,35</sup>	In the absence of any active ocular complications secondary to CVD, a normal tear film function, and stable disease controlled by a single medication, the patient can have laser vision correction. LASIK is preferred over PRK because of the faster healing time and less risk of corneal haze and scarring.	?
Diabetes Mellitus (DM) <sup>36,37</sup>	In well controlled DM, with normal corneal sensation, and no retinopathy, patients can undergo laser vision correction. LASIK is preferred over PRK because of the potential for poor epithelial healing in diabetics.	?
Nursing <sup>38</sup>	Hormonal changes during nursing can potentially alter the refractive error. When the prescription returns to the pre-pregnancy level, the patient can have LASIK or PRK.	?
Pregnancy <sup>39,40</sup>	Hormonal changes during pregnancy can alter the refractive error. In addition, there is a risk of transferring eye medications to the infant. When the prescription returns to the pre-pregnancy level, the patient can have LASIK or PRK.	✗

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## Systemic Medications:

All medications should be documented, as there are rare situations in which drugs can affect the outcomes. (See Table 5)

Table 5		
FINDINGS	COMMENTS	INDICATION
Blood Thinners: Antiplatelet (aspirin, Plavix), and Anticoagulants (Coumadin, Heparin, Pradaxa) <sup>1,2</sup>	LASIK and PRK can be performed with good outcomes. There is an increased risk of a subconjunctival hemorrhage from the suction ring used to create the LASIK flap.	
Amiodarone <sup>41</sup>	An antiarrhythmic medication used to treat and prevent a number of types of irregular heartbeats. Although there were concerns in the past of doing laser vision correction in patients on Amiodarone, recent studies have shown satisfactory outcomes.	
Accutane (Isotretinoin) <sup>42</sup>	Medication used for severe acne can potentially cause a dry eye. Recent studies have shown that patients can have a successful outcome with both LASIK and PRK. However, it is important to only advise surgery if there are no dry eye complaints and clinical examination of the anterior segment is normal.	

## Summary

Laser Vision Correction outcomes have continued to improve secondary to better patient selection, advanced techniques, precise laser technologies, and management of any postoperative concerns. This course provided a detailed overview of patient selection, that was divided into an analysis of the refractive parameters, recognizing any underlying eye conditions, determining any prior ocular surgery, a history of any systemic conditions, and determining any systemic medications. Understanding these important factors allows for a detailed knowledge of the indications and contraindications for laser vision correction leading improved outcomes.

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