

These guidelines have been withdrawn

MOH clinical practice guidelines are considered withdrawn five years after publication unless otherwise specified in individual guidelines. Users should keep in mind that evidence-based guidelines are only as current as the evidence that supports them and new evidence can supersede recommendations made in the guidelines.



CLINICAL PRACTICE GUIDELINES

Laser Refractive Surgery



Ministry
of Health

NMRC
National Medical
Research Council

National Committee
On Ophthalmology

Jul 2001

CLINICAL PRACTICE GUIDELINES

Laser Refractive Surgery

MOH Clinical Practice Guidelines 4/2001

Copyright © 2001 by Ministry of Health, Singapore
Available on the MOH website: <http://www.gov.sg/moh/pub/cpg/cpg.htm>

Statement of Intent

These guidelines are not intended to serve as a standard of medical care. Standards of medical care are determined on the basis of all clinical data available for an individual case and are subject to change as scientific knowledge advances and patterns of care evolve.

The contents of this publication are guidelines to clinical practice, based on the best available evidence at the time of development. Adherence to these guidelines may not ensure a successful outcome in every case, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care. Each physician is ultimately responsible for the management of his/her unique patient in the light of the clinical data presented by the patient and the diagnostic and treatment options available.

Foreword

Myopia is a major public health problem in Singapore with approximately 40% of our adult population known to be myopic.

The Ministry is addressing the problem of increasing rates of myopia through the National Myopia Prevention Programme and the setting up of the Singapore Myopia Registry.

For those who already have myopia, various options, such as spectacles, contact lenses and laser refractive surgery, are available for the correction of myopia. Vision is correctable to normal with spectacles and contact lens if there is no other ocular pathology. However, refractive surgery does not always ensure that unaided visual acuity will be 6/6 after surgery. Certain patients may still require the continued use of spectacles due to under or over correction. Some may experience glare and even lose some vision due to corneal irregularity or scarring. Hence, it is important that patients have realistic expectations when opting for laser refractive surgery. It is also crucial that doctors obtain a full informed consent from the patient prior to surgery.

These guidelines on Laser Refractive Surgery were drawn up by a workgroup appointed by the National Committee on Ophthalmology and will be reviewed regularly as laser refractive surgery is a rapidly evolving field. We are pleased to present these guidelines to all ophthalmologists and doctors.

PROFESSOR TAN CHORH CHUAN
DIRECTOR OF MEDICAL SERVICES

Contents

	Page	
1	Guideline development and objectives	1
2	Levels of evidence and grades of recommendation	4
3	Executive summary of recommendations	5
4	Suitability for laser refractive surgery	7
5	Diagnostic and preoperative investigations	9
6	Informed consent	10
7	Setting of care and anaesthesia	12
8	Sequential versus bilateral simultaneous surgery	13
9	Choice of PRK versus LASIK	15
10	Repeat operations (enhancement)	17
11	Recommendations for evaluation	18
12	Training and certification	19
13	References	21
14	Workgroup members	25

1 Guideline development and objectives

1.1 Incidence of myopia

Approximately one-fourth of the world's population and 44% of Singaporeans are myopic.^{1,2} Myopia appears to affect the Chinese race more than other racial groups and there is a progressively higher prevalence of myopia in those with more years of formal education.^{3,4} Myopia of even low degrees can cause significant deterioration of visual acuity. In the modern society, where many tasks are visually demanding, myopia may even result in economic or social disadvantage.⁵

1.2 Background and scope of guidelines

There are many methods of correcting myopia. Spectacles have been the traditional and time tested method, being effective, safe, predictable and economical. Contact lenses also produce effective and predictable correction of myopia. However, it may rarely cause blinding complications such as microbial keratitis.

Refractive surgery refers to corneal surgical procedures that alter the refractive state of the eye permanently, correcting myopia, astigmatism and hyperopia. Previous techniques have included radial and astigmatic keratotomy, keratomileusis, keratomileusis in-situ, epikeratophakia and keratophakia. All these methods involved a great deal of technical and surgical dexterity with sometimes less than satisfactory predictability, repeatability, safety and precision.

The introduction of the excimer laser has allowed the cornea to be reshaped to correct refractive errors with sub-micron precision and accuracy.⁶ The laser wavelength of 193nm produces sufficient energy to break the inter-molecular bonds of the cornea. Selective removal of tissue from the anterior cornea results in a change of anterior corneal curvature, thereby correcting myopia, astigmatism or hyperopia with good efficacy, predictability and safety.

For the purposes of these guidelines, the term "laser refractive surgery" encompasses two current techniques in excimer laser correction of myopia and myopic astigmatism widely used in Singapore and worldwide:

- Photorefractive keratectomy (PRK), and
- Laser in situ keratomileusis (LASIK).

These guidelines do not cover the use of PRK and LASIK for the correction of hyperopia and hyperopic astigmatism. Neither does it cover other new and evolving refractive surgical procedures, such as the intrastromal corneal ring, phakic intraocular lenses or intrastromal photoablation with nano-second YAG lasers.

PRK is a surgical procedure where the excimer laser is used to reshape the central anterior cornea, after removal of the corneal epithelium.

LASIK is a modification of PRK. It involves using a microkeratome to create a central corneal flap of 8mm to 9mm in diameter and approximately 130µm to 180µm in thickness that is hinged superiorly or nasally. This flap is reflected and the excimer laser beam applied to the exposed corneal stroma. The corneal flap is then replaced without sutures.

Both techniques have been proven to be effective, predictable and safe for the correction of refractive errors.⁷⁻¹²

1.3 Epidemiology

There is an increasing demand by Singaporeans for laser refractive surgery. Rising affluence, active lifestyles that may not be compatible with the use of spectacles or contact lenses, vocational and social demands have all led to increasing numbers of Singaporeans seeking surgical correction for their refractive errors as a matter of a lifestyle choice. Between 1992 to 2000, a total of 10,286 PRK and LASIK procedures were done in the Singapore National Eye Centre (SNEC). A similar number of such procedures have been performed by private practitioners since 1993. The vast majority of these patients are young and economically active.

Although these numbers are small when compared to those undergoing other ophthalmic procedures such as cataract surgery, laser refractive surgery involves operating on patients with otherwise normal vision that can usually be satisfactorily corrected with spectacles or contact lenses. An operative complication or sub-optimal outcome could result in a permanent loss of best corrected vision with socioeconomic repercussions. It is therefore necessary to set out in these guidelines, acceptable practice parameters for laser refractive surgery to ensure the best possible outcome with minimal risk of sight threatening complications in each patient that undergoes laser refractive surgery.

1.4 Objectives of the guidelines

These guidelines have the following objectives:

- To identify appropriate inclusion and exclusion criteria for patients undergoing laser refractive surgery
- To provide parameters for the effective and safe practice of laser refractive surgery
- To identify training and certification requirements for ophthalmologists who want to incorporate laser refractive surgery into their clinical practice

1.5 Target group and methodology

These guidelines have been formulated for ophthalmologists practising laser refractive surgery in institutional and private practice in Singapore.

These guidelines were prepared by the members of the National Committee on Ophthalmology and approved by its members. This document is based on the collective clinical experiences of the members and a thorough review of the existing literature on laser refractive surgery.

2 Levels of evidence and grades of recommendation

Levels of evidence

Level	Type of Evidence
Ia	Evidence obtained from meta-analysis of randomised controlled trials.
Ib	Evidence obtained from at least one randomised controlled trial.
IIa	Evidence obtained from at least one well-designed controlled study without randomisation.
IIb	Evidence obtained from at least one other type of well-designed quasi-experimental study.
III	Evidence obtained from well-designed non-experimental descriptive studies, such as comparative studies, correlation studies and case studies.
IV	Evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities.

Grades of recommendation

Grade	Recommendation
A (evidence levels Ia, Ib)	Requires at least one randomised controlled trial as part of the body of literature of overall good quality and consistency addressing the specific recommendation.
B (evidence levels IIa, IIb, III)	Requires availability of well conducted clinical studies but no randomised clinical trials on the topic of recommendation.
C (evidence level IV)	Requires evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities. Indicates absence of directly applicable clinical studies of good quality.
GPP (Good practice points)	Recommended best practice based on the clinical experience of the guideline development group.

3 Executive summary of recommendations

C Appropriate patients for laser refractive surgery should be at least 18 years old, with a cycloplegic refraction of $\geq -1.0D$, and a stable refractive error.

Grade C, Level IV

C A comprehensive medical and ophthalmic history, complete ocular examination including visual acuity, slit lamp biomicroscopy, dilated retinal examination, determination of refractive status, tonometry, keratometry and corneal topography should be performed on all patients undergoing laser refractive surgery.

Grade C, Level IV

C A full informed consent for laser refractive surgery must be obtained from each patient prior to surgery.

Grade C, Level IV

C Sequential surgery between the two eyes of a patient is preferred over bilateral simultaneous surgery.

Grade C, Level IV

A The choice between PRK and LASIK for the correction of a refractive error should be made based on the ophthalmologist's technical expertise, the equipment available and the patient's refractive error. The patient should also be informed of the choices available for laser refractive surgery and advised as to which of the 2 procedures would be appropriate.

Grade A, Level Ib

B There should be an interval of at least 3 months after the initial surgery for LASIK and 6 months after the initial surgery for PRK, before a repeat operation is carried out for undercorrection and regression after laser refractive surgery.

Grade B, Level IIb

C An Institutional Review Board (IRB) should determine the training requirements and certify the competence and currency of ophthalmologists who practice laser refractive surgery.

Grade C, Level IV

4 Suitability for laser refractive surgery

4.1 Inclusion criteria

Appropriate patients for laser refractive surgery should have the following criteria:

- Age 18 years or older at last birthday
- Myopia of at least -1.0D by cycloplegic refraction - the upper limit of myopia that can be treated safely is dependent on other factors such as the laser algorithm, central corneal thickness and the ophthalmologist's assessment of the risk of inducing corneal scarring, progressive corneal ectasia or irregular astigmatism with high myopic laser treatments
- Stable refractive error that does not fluctuate by $> 0.5D$ per year for those with $\leq -6D$ of preoperative myopia; and $> 1.0D$ per year for patients with $> -6D$ of preoperative myopia.

C Appropriate patients for laser refractive surgery should be at least 18 years old, with a cycloplegic refraction of $\geq -1.0D$, and a stable refractive error.

Grade C, Level IV

4.2 Indication

Any person with an appropriate refractive error for laser refractive surgery that is unwilling or unable to wear spectacles or contact lenses for vision correction.

4.3 Exclusion criteria

It is the responsibility of the ophthalmologist to determine an individual patient's suitability to undergo laser refractive surgery. The exclusion criteria listed below are by no means exhaustive. If the decision to proceed with surgery is made in the presence of a relative

exclusion criteria, the patient must be made fully aware of the possible clinical sequelae.

4.3.1 Absolute contraindications

- Keratoconus
- Irregular astigmatism

4.3.2 Relative (ocular) contraindications

- One eyed patient
- Severe keratitis sicca (dry eyes)
- Lagophthalmos
- Severe atopic eye disease.
- Untreated blepharitis/meibomitis
- Past history of herpes simplex virus keratitis
- Neurotrophic cornea
- Pre-existing glaucoma, visually significant cataract, uveitis or retinal disease
- Patent deep corneal vascularization within 1 mm of the planned ablation zone or lamellar keratectomy incision

4.3.3 Relative (systemic) contraindications

- Collagen vascular disorders, eg. rheumatoid arthritis, systemic lupus, etc.
- Immunocompromised
- Diabetes mellitus
- Pregnancy
- On systemic medications that may affect wound healing, e.g. systemic steroids, hormone replacement therapy

5 Diagnostic and preoperative investigations

C A comprehensive patient history, ocular examination, measurement of refractive status and ancillary investigations are necessary to determine each individual patient's suitability to undergo laser refractive surgery.

Grade C, Level IV

5.1 Compulsory investigations

- Complete patient history, including present and past medical history and drug allergies.
- Unaided and best corrected distance and near visual acuity with Snellen or LogMAR charts.
- Complete ocular examination including slit lamp biomicroscopy and dilated binocular indirect ophthalmoscopic examination of the retina.
- Measurement of intraocular pressures by tonometry.
- Measurement of refractive status with manifest and cycloplegic refraction. Refractions obtained by automated refractometers are inaccurate and must not be used exclusively for the preoperative and postoperative assessment of patients.¹³
- Keratometry to document preoperative astigmatism.
- Computerised videokeratography (corneal topography) to detect irregular astigmatism and keratoconus.
- Central corneal pachymetry (for LASIK only).

5.2 Optional/recommended investigations

- Measurement of pupil size in mesopic/scotopic conditions to allow appropriate counselling of potential night vision problems to patients with large pupils in dim lighting.
- Contrast sensitivity measurements.
- Endothelial cell counts preoperatively and postoperatively (for LASIK only).

6 Informed consent

C A full informed consent for laser refractive surgery must be obtained from each patient prior to surgery.

Grade C, Level IV

It is mandatory that an informed consent be obtained from the patient prior to surgery. To be legally valid, the informed consent provided by the patient must be fully informed and voluntary; and the patient provided with sufficient information concerning the nature of the procedure, risks, potential complications, benefits and alternative treatments to form the basis of a reasonable decision on whether or not to proceed with the surgery. The patient must also be given enough time to evaluate the information provided and not be unduly encouraged to undergo the procedure without an adequate opportunity to consider the issues fully.¹⁴

The informed consent document should contain, but not be limited to the following information:¹⁵

6.1 Description of PRK or LASIK

- Purpose of PRK or LASIK surgery.
- Description of PRK or LASIK surgery.
- The effect of PRK/LASIK on the eye.
- The use of anaesthesia and/or sedative, or any other medication.

6.2 Discussion of side effects, risks and complications, which include

- Commonly experienced visual effects after surgery, even if temporary (e.g. blurred vision, starburst effects, haloes, anisometropia, etc.).
- Possibility that temporary visual side effects may become permanent.
- Potentially serious complications, even if infrequent or uncommon (e.g. corneal vascularization, infective keratitis,

corneal perforation, corneal scarring, epithelial healing problems, irregular astigmatism, endophthalmitis, cataract, retinal detachment, glaucoma, partial or total loss of vision, complications requiring additional treatment and/or surgery etc.).

- Possibility of loss of best corrected visual acuity.
- Possibility of postoperative pain or discomfort.
- Chance of over and undercorrection.
- Possibility that spectacles or contact lenses may still be required after surgery.
- Possible difficulties in fitting contact lenses postoperatively.
- Chance of additional procedures (retreatment/enhancement).
- Probability of presbyopia.
- Possibility of ptosis, diplopia, etc. postoperatively.
- Possibility of disqualification or inability to participate in certain vocations after surgery.
- Possibility of inability to drive a vehicle or function in dark conditions due to night vision problems after surgery.

6.3 Discussion of alternatives to PRK/LASIK

This may include continued use of spectacles or contact lenses, or other surgical procedures.

6.4 Acknowledgement of understanding and signature of patient, surgeon and translator (if utilised)

7 Setting of care and anaesthesia

Laser refractive procedures are performed on an outpatient basis, either hospital based, office clinic based or in free standing surgical centres. All of these settings offer appropriate settings for laser refractive surgery. Each of these surgical facilities should provide heat sterilization of instruments. Cardiopulmonary resuscitation facilities should be available.

Topical anaesthesia, with or without an oral sedative, is the method of choice for achieving anaesthesia for the purpose of laser refractive surgery.

8 Sequential versus bilateral simultaneous surgery

PRK and LASIK can either be done sequentially, with an interval of days to weeks between the 2 eyes of a patient, or both eyes operated on simultaneously at the same session. Each technique has its own merits and disadvantages.

Sequential laser refractive surgery is the more conservative approach. It allows the patient time to assess if he is satisfied with the results of the surgery on one eye before proceeding with surgery on the fellow eye some days to weeks later. It also protects the patient from potentially sight threatening complications that could affect both eyes if there were malfunction of the laser and/or microkeratome, or possibility of microbial keratitis from contamination of operative instruments or solutions. However, sequential surgery induces a temporary state of anisometropia which some patients may find inconvenient.

Bilateral simultaneous surgery has the advantage of convenience to the patient, saving an extra visit to the surgical facility for operation on the fellow eye as in sequential surgery. It also avoids the creation of temporary anisometropia, which can be troubling for some patients. It should be noted that although there have been peer reviewed evidence suggesting that bilateral simultaneous laser refractive surgery is *as safe as* sequential surgery, there has been no evidence to date to suggest that it is *safer or better*.^{16,17}

C Sequential surgery between the two eyes of a patient is preferred over bilateral simultaneous surgery.

Grade C, Level IV

In the light of current scientific evidence, the Committee recommends a conservative approach of sequential laser refractive surgery, with a minimum surgery interval of 1 day between eyes. In patients who elect to undergo bilateral simultaneous surgery, the surgeon should ensure that the patient understands the unique risks of bilateral simultaneous surgery. Specifically, the possibility of bilateral visual

impairment if an intra or post-operative complication were to occur in both eyes must be explained to the patient.

9 Choice of PRK versus LASIK

Both PRK and LASIK are effective, predictable and safe surgical procedures for the correction of myopia and astigmatism. However, PRK has disadvantages such as post-operative pain and delayed post-operative visual rehabilitation because of the epithelial defect, as well as a risk of corneal haze and scarring due to disruption of Bowman's layer. The incidence of corneal scarring appears to be correlated with increasing degrees of attempted myopic correction.¹⁸ There may also be a risk of glaucoma from increased intraocular pressure due to steroid response from prolonged use of topical steroids after PRK. Therefore, the results of PRK for high myopia have tended to be less impressive, with a higher incidence of corneal scarring leading to loss of best corrected visual acuity, regression as well as poorer predictability.^{7,19}

In LASIK the corneal epithelium is not removed as in PRK, hence, there is less post-operative pain and faster visual rehabilitation. Since Bowman's layer is not disrupted by the excimer laser, there is a negligible incidence of corneal scarring. However, LASIK is a more technically demanding operation with the potential to cause serious sight-threatening complications due to the lamellar keratectomy, compared to PRK. It also requires the investment in an expensive microkeratome, in addition to an excimer laser. This results in LASIK being a more expensive procedure.

As LASIK has a faster visual recovery and less postoperative pain when compared to PRK, many patients and ophthalmologists favour LASIK over PRK for the correction of all degrees of myopia as it gives greater satisfaction for both patient and surgeon. However, aside from the postoperative pain and delayed visual recovery, Hersh and colleagues²⁰ have shown in a recent prospective randomised clinical trial that there is no evidence to suggest that LASIK is superior to PRK, in terms of visual acuity, predictability, stability, corneal haze and corneal flap complications, for the correction of myopia between -6D to -15D. The results of PRK and LASIK for correction of myopia < -6D have been essentially identical.^{21,22}

A The choice between PRK and LASIK for the correction of a patient's refractive error should be made based on the ophthalmologist's technical expertise, the equipment available and the patient's refractive error. The patient should also be informed of the choices available for laser refractive surgery and advised as to which of the 2 procedures would be appropriate.

Grade A, Level Ib

10 Repeat operations (enhancements)

Approximately 8% to 38% of eyes that undergo PRK²³⁻²⁶ and 1% to 17% of eyes that undergo LASIK^{10,21,28} require a repeat operation for undercorrection and regression. The retreatment rate increases with increasing degrees of myopia or astigmatism that was initially treated.²⁶

Retreatment should not be performed unless the patient is unsatisfied with the result of the first operation. Retreatment should only be performed when refractive stability is attained. For PRK, this is usually 6 months or more after the initial surgery.²⁹ For LASIK, retreatment can usually be done 3 months or more after the initial surgery as refractive stability is usually attained earlier than PRK.³⁰

B There should be an interval of at least 3 months after the initial surgery for LASIK and 6 months after the initial surgery for PRK, before a repeat operation is carried out for undercorrection and regression after laser refractive surgery.

Grade B, Level IIB

Before retreatment surgery is performed, the following preoperative tests and investigations must be performed:

- Two separate manifest and/or cycloplegic refractions performed at least 1 month apart to document refractive stability.
- A corneal topographic map of the operative eye to exclude central islands, decentration of the ablation zone or induced irregular astigmatism from the previous surgery.
- Central corneal pachymetry to ensure there is enough residual corneal stroma left for the planned repeat ablation (for LASIK procedures only).

11 Recommendations for evaluation

The main outcome measures for laser refractive surgery include:

- Unaided visual acuity - Percentage of eyes seeing 6/12 or 6/6 and better.
- Predictability - Percentage of eyes within +/- 1D of the intended correction.
- Safety
 - Percentage of eyes with loss of ≥ 2 Snellen lines of best spectacle corrected visual acuity.
 - Incidence of operative and post-operative adverse reactions or complications.

**Table of Expected Outcomes after PRK & LASIK
(6 months follow-up)**

	PRK		LASIK	
	$\leq -6D$	$> -6D$ to $-10D$	$\leq -6D$	$> -6D$ to $-10D$
Preoperative Myopia				
Unaided Visual Acuity 6/12 or better	94%	90%	95%	88%
Eyes within +/- 1D of Intended Correction	88%	73%	95%	84%
Eyes losing ≥ 2 lines of Snellen acuity	2%	7%	0.5%	1%

**Based on data from the Singapore National Eye Centre excimer laser database (1992 to 2000).*

12 Training and certification

C An Institutional Review Board (IRB) should determine the training requirements and certify the competence and currency of ophthalmologists who practice laser refractive surgery.

Grade C, Level IV

An IRB should designate experienced laser refractive surgeons as trainers for ophthalmologists who wish to embark on laser refractive surgery and also certify the competence and currency of each ophthalmologist after the training is completed. The recommended certification and maintenance of currency requirements differ between PRK and LASIK as the latter procedure is technically more demanding with a higher risk of sight threatening complications.
28,31,32

12.1 Pre-requisites for performing PRK

- Attended an excimer laser PRK certification course (certificate required).
- Observed at least 5 cases of PRK.
- Supervised in at least 5 cases of PRK.
- Have adequate medical malpractice insurance.
- Perform at least 4 cases of PRK per year to keep current with the procedure.
- Final accreditation is subject to approval by the IRB after attainment of the above criteria.

12.2 Pre-requisites for performing LASIK

- Attended a LASIK certification course (certificate required).
- Have performed at least 20 cases of PRK as the primary surgeon and accredited as per the PRK credentialling requirements.
- Observed at least 5 cases of LASIK.
- Supervised in at least 10 cases of LASIK.
- Have adequate medical malpractice insurance.

- Perform at least 4 cases of LASIK per year to keep current with the procedure.
- Final accreditation is subject to approval by the IRB after attainment of the above criteria.

13 References

1. Curtin BJ. *The Myopias: Basic Science and Clinical Management*. Philadelphia: Harper and Row; 1985.
2. Au Eong KG, Tay TH, Lim MK. Race, culture and myopia in 110,236 young Singaporean males. *Singapore Med J* 1993; 34:29-32.
3. Au Eong KG, Tay TH, Lim MK. Education and myopia in 110,236 young Singaporean males. *Singapore Med J* 1993; 34:489-92.
4. Chow YC, Dhillon B, Chew PTK, et al. Refractive errors in Singapore medical students. *Singapore Med J* 1990; 31:472-3.
5. Foulds WS. The natural history of myopia. In: McGhee CNJ, Taylor HR, Gartry DS, Trokel SL, ed. *Excimer Lasers in Ophthalmology - Principles and Practice*. United Kingdom: Butterworth-Heinemann; 1997. p. 65-78.
6. McDonald MB, Liu JC, Byrd TJ, et al. Central photorefractive keratectomy for myopia. Partially sighted and normally sighted eyes. *Ophthalmology* 1991; 98:1327-37.
7. Chan WK, Heng WJ, Tseng P, et al. Photorefractive keratectomy for myopia of 6 to 12 diopters. *J Refract Surg* 1995; 11:S286-92.
8. Balakrishnan V, Lim AS, Low CH, et al. Excimer laser photorefractive keratectomy in Singapore - a new treatment modality for myopia. *Singapore Med J* 1993; 34:309-12.
9. Hersh PS, Stulting RD, Steinert RF, et al. Results of phase III excimer laser photorefractive keratectomy for myopia. The Summit PRK Study Group. *Ophthalmology* 1997; 104:1535-53.
10. Salah T, Waring GO III el Maghraby A, Moadel K, et al. Excimer laser in situ keratomileusis under a corneal flap for myopia of 2 to 20 diopters. *Am J Ophthalmol* 1996; 121:143-55.

11. Knorz MC, Wiesinger B, Liermann A, et al. Laser in situ keratomileusis for moderate and high myopia and myopic astigmatism. *Ophthalmology* 1998; 105:932-40.
12. Dulaney DD, Barnett RW, Perkins SA, et al. Laser in situ keratomileusis for myopia and astigmatism: 6 month results. *J Cataract Refract Surg* 1998; 24:758-64.
13. Siow KL, Chan WK, Low CH, et al. Problems of refraction after photorefractive keratectomy. *J Am Optom Assoc* 1996; 67:755-61.
14. Practice Guideline Committee. Practice Guidelines for Refractive Keratotomy. USA: International Society of Refractive Surgery; 1995.
15. Practice Guideline Committee. Consent Guidelines for Refractive Keratotomy. USA: International Society of Refractive Surgery; 1995.
16. BahÁecioglu H, Ozdamar A, Aktun R, et al. Simultaneous and sequential photorefractive keratectomy. *J Refract Surg* 1995; 11:S261-2.
17. Waring GO III, Carr JD, Stulting RD, et al. Prospective randomized comparison of simultaneous and sequential bilateral LASIK for the correction of myopia. *Tr Am Ophth Soc* 1997; 95:271-84.
18. Heitzmann J, Binder PS, Kassab BS, et al. The correction of high myopia using the excimer laser. *Arch Ophthalmol* 1993; 111:1627-34.
19. Carson CA, Taylor HR. Excimer laser treatment for high and extreme myopia. The Melbourne Excimer Laser and Research Group. *Arch Ophthalmol* 1995; 113:431-6.
20. Hersh PS, Brint SF, Maloney RK, et al. Photorefractive keratectomy versus laser in situ keratomileusis for moderate to high myopia. A randomized prospective study. *Ophthalmology* 1998; 105:1512-22.
21. Lindstrom RL, Hardten DR, Chu YR. Laser in situ keratomileusis (LASIK) for the treatment of low, moderate and high myopia. *Tr Am Ophth Soc* 1997; 95:285-96.

22. Tengroth B, Epstein D, Fagerholm P, et al. Excimer laser photorefractive keratectomy for myopia. Clinical results in sighted eyes. *Ophthalmology* 1993; 100:739-45.
23. Gartry DS, Larkin DF, Hill AR, et al. Retreatment for significant regression after excimer laser photorefractive keratectomy. A prospective, randomized, masked trial. *Ophthalmology* 1998; 105:131-41.
24. Hefetz L, Krakowski D, Haviv D, et al. Results of a repeated excimer laser photorefractive keratectomy for myopia. *Ophthalmic Surg Lasers* 1997; 28:8-13.
25. Ali JL, Artola A, Claramonte PJ, et al. Complications of photorefractive keratectomy for myopia: two year follow-up of 3000 cases. *J Cataract Refract Surg* 1998; 24:619-26.
26. Snibson GR, McCarty CA, Aldred GF, et al. Retreatment after excimer laser photorefractive keratectomy. The Melbourne Excimer Laser Group. *Am J Ophthalmol* 1996; 121:250-7.
27. Knorz MC, Liermann A, Seiberth V, et al. Laser in situ keratomileusis to correct myopia of -6.00 to -29.00 diopters. *J Refract Surg* 1996; 12:575-84.
28. Gimbel HV, Basti S, Kaye GB, et al. Experience during the learning curve of laser in situ keratomileusis. *J Cataract Refract Surg* 1996; 22:542-50.
29. Snibson GR. Regression and retreatment. In: McGhee CNJ, Taylor HR, Gartry DS, Trokel SL, ed. *Excimer Lasers in Ophthalmology - Principles and Practice*. United Kingdom: Butterworth-Heinemann; 1997. p.403-19.
30. Chayet AS, Assil KK, Montes M, et al. Regression and its mechanisms after laser in situ keratomileusis in moderate and high myopia. *Ophthalmology* 1998; 105:1194-9.

31. Filatov V, Vidaurri Leal JS , Talamo JH. Selected complications of radial keratotomy, photorefractive keratectomy, and laser in situ keratomileusis. *Int Ophthalmol Clin* 1997; 37:123-48.
32. Farah SG, Azar DT, Gurdal C, et al. Laser in situ keratomileusis: Literature review of a developing technique. *J Cataract Refract Surg* 1998; 24:989-1006.

14 Workgroup members

The members of the workgroup are:

Chairman: Dr Chan Wing Kwong

Members: Assoc Prof Vivian Balakrishnan
Dr Cordelia Chan
Dr Chan Tat Keong
Dr Chee Soon Phaik
Dr Heng Wee Jin
Dr Lee Chin Piaw
Dr Lee Hung Ming
Dr Lim Li
Dr Low Cze Hong
Dr Steve Seah
Assoc Prof Donald Tan
Dr Peter Tseng
Dr Ronald Yeoh
Dr Victor Yong

Laser Refractive Surgery



Ministry
of Health

NMRC
National Medical
Research Council

National Committee
On Ophthalmology

PATIENT SELECTION

Appropriate patients for laser refractive surgery should be at least 18 years old, with a cycloplegic refraction of $\geq -1.0D$, and a stable refractive error.

CONTRAINDICATIONS TO REFRACTIVE SURGERY

Absolute contraindications

- Keratoconus
- Irregular astigmatism

Relative (ocular) contraindications

- One eyed patient
- Severe keratitis sicca (dry eyes)
- Lagophthalmos
- Severe atopic eye disease.
- Untreated blepharitis/meibomitis
- Past history of herpes simplex virus keratitis
- Neurotrophic cornea
- Pre-existing glaucoma, visually significant cataract, uveitis or retinal disease
- Patent deep corneal vascularization within 1 mm of the planned ablation zone or lamellar keratectomy incision

Relative (systemic) contraindications

- Collagen vascular disorders, eg. rheumatoid arthritis, systemic lupus, etc.
- Immunocompromised
- Diabetes mellitus
- Pregnancy
- On systemic medications that may affect wound healing, e.g. systemic steroids, hormone replacement therapy

Diagnostic and Pre-operative Investigations

Compulsory investigations

- Complete patient history, including present and past medical history and drug allergies.
- Unaided and best corrected distance and near visual acuity with Snellen or LogMAR charts.
- Complete ocular examination including slit lamp biomicroscopy and dilated binocular indirect ophthalmoscopic examination of the retina.
- Measurement of intraocular pressures by tonometry.
- Measurement of refractive status with manifest and cycloplegic refraction. Refractions obtained by automated refractometers are inaccurate and must not be used exclusively for the preoperative and postoperative assessment of patients.
- Keratometry to document preoperative astigmatism.
- Computerised videokeratography (corneal topography) to detect irregular astigmatism and keratoconus.
- Central corneal pachymetry (for LASIK only).

Optional/recommended investigations

- Measurement of pupil size in mesopic/scotopic conditions to allow appropriate counselling of potential night vision problems to patients with large pupils in dim lighting.
- Contrast sensitivity measurements.
- Endothelial cell counts preoperatively and postoperatively (for LASIK only).

CHOICE OF PRK (PHOTOREFRACTIVE KERATECTOMY) VERSUS LASIK (LASER IN SITU KERATOMILEUSIS)

The choice between PRK and LASIK for the correction of a refractive error should be made based on the ophthalmologist's technical expertise, the equipment available and the patient's refractive error. The patient should also be informed of the choices available for laser refractive surgery and advised as to which of the 2 procedures would be appropriate.

REPEAT OPERATIONS (ENHANCEMENTS)

There should be an interval of at least 3 months after the initial surgery for LASIK and 6 months after the initial surgery for PRK, before a repeat operation is carried out for undercorrection and regression after laser refractive surgery.