KREMER EXCIMER LASER SERIAL NO. KEA940202

PHYSICIAN MANUAL

Document P970005 - PM

CAUTION: Federal Law restricts this device to commercial use and treatment of patients by or on the order of a physician or other licensed practitioner.

This document provides information concerning the intended clinical use of the Kremer Excimer Laser Serial No. KEA940202. For complete information concerning system components, safety instructions, maintenance, and troubleshooting, refer to the Kremer Excimer Laser Serial No. KEA940202 Operator Instruction Manual (Document KEA0100).

Carefully read all instructions prior to use. Observe all contraindications, warnings, and precautions noted in these instructions. Failure to do so may result in patient and/or user complications.

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GENERAL WARNINGS

The following warnings need to be read and fully understood before operating this laser refractive surgical system. Each warning identifies conditions or practices that may cause personal injury, loss of life or cause damage to this equipment or surrounding property:

WARNING! RESTRICTED DEVICE: U.S. Federal Law restricts the commercial use of this equipment to treatment of patients by physicians or other licensed eye care practitioners. Practitioners who use this device must have prior corneal surgical experience and be trained in laser system calibration.

WARNING! Do not operate this laser in the presence of flammable anesthetics or volatile substances such as alcohol.

WARNING! TOXIC AND COMPRESSED GAS HANDLING The air, argon-fluorine premix and helium gases used in this system are stored in high pressure gas cylinders. Improper handling, storage, adjustments or modifications to the gas cylinder or any gas carrying line or component can result in a high pressure gas leak or possible explosion. Additionally the argon fluorine premix is highly toxic and can be sensed by its sharp, penetrating odor and eye, nose and throat irritation.

Before anyone works with either the gas cylinders or gas handling equipment, it is recommended that the person be trained in the proper handling of toxic and compressed gases. Gas safety instructions provided in the operator's manual shall be fully understood and followed.

WARNING! Hazardous conditions may result if this equipment is used in a manner other than that described in the manual. This use includes but is not limited to performance of procedures, control usage and adjustments.

WARNING! POTENTIAL SKIN AND/OR EYE EXPOSURE The Kremer Excimer Laser Serial No. KEA940202 is classified as a Class IV laser with a 193 nanometer output. Although this class of laser is potentially hazardous to the skin and surface layers of the cornea, the laser energy will not enter the eye and will not damage the retina or crystalline lens. The beam path is enclosed except for the area of the optics extension located vertically immediately below the microscope and above the operating table. Laser beam reflectivity from objects in the operating room including surgical instruments is relatively low.

TABLE OF CONTENTS

Kremer Excimer Laser Serial No. KEA940202

Physician Manual

I. DEVICE DESCRIPTION

The Kremer Excimer Laser Serial No. KEA940202 operates on the principle that radiation at the 193 nm wavelength is highly absorbed by the cornea.[4] The 193 nm wavelength photon energy disrupts the intramolecular collagen bonds of corneal tissue,[4] causing the ablated tissue to denature. The 193 nm wavelength disruption is precise in that, for a given intensity (or energy per pulse), the depth of an ablated area corresponds with the number of laser pulses and the area of tissue removal corresponds with the diameter of the incident laser beam on the tissue.[1,2] In addition, the non-thermal 193 nm wavelength results in minimal damage to surrounding tissue.[1,2,3,5]

The Kremer Excimer Laser Serial No. KEA940202 consists of the following system components:

- *Excimer Laser:*

An argon-fluorine excimer laser provides the following characteristics:

Laser wavelength:	193 nm
Laser pulse duration:	8-30 ns (FWHM)
Repetition rate:	10 Hz
Fluence (at the eye):	134 mJ/cm2
Ablation zone:	6.0 mm diameter
Composition of gases:	
ArF Premix	Argon (97.73%)
	Fluorine (2.17%)
Buffer:	Helium (99.999% purity)
For internal purging:	Helium

- *Laser Beam Delivery System:*
- *Gas Management System:*
- *Patient Management System:*
- *Computer Control System:*

Note: Additional details regarding the operation of this laser can be found in the Kremer Excimer Laser Serial No. KEA940202 Operator Instruction Manual (Document KEA0100).

II. INDICATIONS FOR USE

The Kremer Excimer Laser Serial No. KEA940202, using a 6.0 mm ablation zone, is indicated for myopic and astigmatic laser assisted in-situ keratomilieusis (LASIK) in patients:

- with myopia ranging between -1.0 and -15.0 diopters (D) with or without astigmatism ranging from 0.0 D to 5.00 D;
- who are 18 years of age or older; and,
- with stable refraction over the 1-year period prior to surgery. Note: Patients between 18 and 20 years old should not demonstrate a shift in refraction greater than 0.5 D. Patients 21 years and older should not demonstrate a shift greater than 1.0 D.

III. CONTRAINDICATIONS, WARNINGS, AND PRECAUTIONS

CONTRAINDICATIONS - Patients with the following conditions should not be considered for this procedure:

- Active ocular / systemic infection
- Fuchs' corneal dystrophy
- Keratoconus
- Central corneal scars affecting visual acuity
- Cornea too thin to achieve the desired correction
- Pregnant or nursing women

WARNINGS - Patients presenting with the following condition(s) should be considered for this treatment only after careful assessment of the potential risk and benefit to the specific patient:

- Previous herpetic keratitis[1]
- Collagen vascular disorders[2]
- Ablation of corneal stroma to less than 200μm from the endothelium
- Ablation depths within less than 250 microns from the endothelium may result in the loss of two or more lines of BSCVA.

PRECAUTIONS - The safety and effectiveness of this procedure has not been established in patients presenting with the following conditions:

- Severe dry eye syndrome
- Glaucoma
- Uveitis
- Blepharitis
- Psoriasis
- Immunosuppression
- Systemic or topical use of steroids
- History of keloid formation

- Due to the small sample of eyes treated in the Cohort 2 study with myopia of –13.0 D or more (1%, 6/665) or astigmatism of –4.0 D or more (1.8%, 13/720), the reported safety and effectiveness for this refractive range is less reliable than for eyes with less severe myopia or astigmatism.
- Patients with high myopia greater than –7.0 D whose BSCVA was 20/20 preoperatively have a 9% chance of being worse than 20/25 postoperatively at the 6 month postoperative interval. .
- The effects of the LASIK procedure on visual performance under poor lighting conditions have not been determined. It is possible, following LASIK treatment, that patients may find it difficult to see in conditions such as very dim light, rain, snow, fog or glare from bright lights at night.
- Patients may still need glasses or contact lenses.
- There is no safety and effectiveness data for surface ablation performed with this laser.

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1. Patient needs to understand risks associated with corneal trauma and possible re-activation of herpetic keratitis.
2. Patient needs to understand the risks associated with collagen vascular disorders and their associated corneal involvement. The patient may be included if sufficient understanding of possible complications is demonstrated. Consideration should be given to treatment on a monocular basis.

IV. PATIENT SELECTION

A. INCLUSION / EXCLUSION CRITERIA

Consideration should be given to the following in determining the appropriate patients for LASIK:

- ≥18 years old;
- primary myopia between –1.0 D and –15.0 D with or without astigmatism up to 5.0 D;
- with stable refraction over the 1-year period prior to surgery. Note: Patients between 18 and 20 years old should not demonstrate a shift in refraction greater than 0.5 D. Patients 21 years and older should not demonstrate a shift greater than 1.0 D.
- demonstrated desire for independence from spectacles or contact lenses;
- no soft contact lens wear for 2 weeks prior to surgery or no hard contact lens wear for 3 weeks prior to surgery;
- willingness to comply with all postoperative follow-up visits.

Patients should sign an informed consent form, and be instructed about the risks associated with LASIK, and be informed of all alternatives for the correction of their refractive error.

Patients who do not meet all of the above inclusion criteria should not be treated. Patients with any of the following conditions should also be excluded: active ocular or systemic infection; severe dry eye syndrome; Fuchs' dystrophy; anterior basement membrane dystrophy; keratoconus associated with thinning; and chronic topical steroid use. Patients with central corneal scars that affect visual acuity or whose corneas are too thin to permit the desired correction should also be excluded from treatment.

B. ADVERSE EVENTS AND COMPLICATIONS

Table 1. Summary of Adverse Events and Complications Experienced in Cohort 2.

	Cohort 2 (%)				
Adverse Events / Complicati	Operative[1]	1 month	3 months	6 months	12 months
Corneal infiltrate		0/873 (0)	0/814 (0)	0/657 (0)	0/308 (0)
Corneal edema > 1 mo		2/873 (0.2)	1/814 (0.1)	0/657 (0)	0/308 (0)
Flap misalignment		1/873 (0.1)	0/814 (0)	0/657 (0)	0/308 (0)
Retinal detachment		0/873 (0)	0/814 (0)	0/657 (0)	1/308 (0.3)
Corneal Edema < 1 mo	30/873 (3.4)				
Incomplete cap-abort procedur	4/1342 (0.3)				
No hinge on flap	9/1342 (0.7)				
Epithelial defect - Central		1/873 (0.1)	1/814 (0.1)	0/657 (0)	0/308 (0)
Epithelial defect - Peripheral		1/873 (0.1)	0/814 (0)	1/657 (0.2)	0/308 (0)
Epithelium in interface-Central		1/873 (0.1)	0/814 (0)	1/657 (0.2)	0/308 (0)
Epithelium in interface-Periph.		8/873 (0.9)	10/814 (1.2)	8/657 (1.2)	1/308 (0.3)
Interface foreign bodies		126/873 (14)	128/814 (14)	95/657 (15)	27/308 (9)
Cap striae		9/873 (1.0)	6/814 (0.7)	5/657 (0.8)	1/308 (0.3)
Pain		4/873 (0.5)	4/814 (0.5)	3/657 (0.5)	2/308 (0.7)
Glare[2]				5/661 (0.8)	4/269 (1.5)
Halos[2]				7/661 (1)	0/269 (0)
Night Driving Problems[2]				7/661 (1)	2/269 (0.7)
Double Vision / Ghosts[2]				10/661 (1.5)	2/269 (0.7)
Foreign Body Sensation[2]				5/661 (0.8)	0/269 (0)
Anxiety[2]				0/661 (0)	0/269 (0)

1. Adverse events occurring operatively and up to 1 month postoperatively.
2. These events were reported 6 and 12 months after final treatment.

Table 2. Summary of Adverse Events and Complications Experienced in Cohort 1.

	Cohort 1 (%)				
Adverse Events	Operative[1]	1 month	3 months	6 months	12 months
Corneal infiltrate		0/804 (0)	0/910 (0)	1/788 (0.1)	0/752 (0)
Corneal edema ≥ 1 mo		14/804 (1.7)	4/910 (0.4)	0/788 (0)	0/752 (0)
Flap misalignment		0/804 (0.1)	0/910 (0)	0/788 (0)	0/752 (0)
Retinal detachment		0/804 (0)	0/910 (0)	0/788 (0)	1/752 (0.1)
Complications					
Corneal Edema < 1 mo	43/741 (5.8				
Incomplete cap-abort procedur	1/1141 (0.1				
No hinge on flap	20/1141 (1.8				
Epithelial defect - Central		2/741 (0.3)	1/859 (0.1)	2/750 (0.3)	0/687 (0)
Epithelial defect - Peripheral		1/741 (0.1)	1/859 (0.1)	0/750 (0)	2/687 (0.3)
Epithelium in interface-Central		2/741 (0.3)	0/859 (0)	1/750 (0.1)	0/687 (0)
Epithelium in interface-Periph.		8/741 (1.1)	12/859 (1.4)	15/750 (2)	10/687 (1.5)
Interface foreign bodies		71/741 (9.6)	78/859 (9.1)	50/750 (6.7)	43/687 (6.3)
Cap striae		3/741 (0.4)	7/859 (0.8)	5/750 (0.7)	3/687 (0.4)
Pain		4/741 (0.5)	1/859 (0.1)	3/750 (0.4)	2/687 (0.3)
Glare[2]				23/726 (3.2)	16/678 (2.4)
Halos[2]				14/726 (1.9)	6/678 (0.9)
Night Driving Problems[2]				30/726 (4.1)	15/678 (2.2)
Double Vision / Ghosts[2]				6/726 (0.8)	5/678 (0.7)
Foreign Body Sensation[2]				1/726 (0.1)	0/678 (0)
Anxiety[2]				1/726 (0.1)	1/678 (0.1)

1. Adverse events occurring operatively and up to 1 month postoperatively.
2. These events were reported 6 and 12 months after final treatment.

- Adverse events

  Adverse events included corneal infiltrate (1 eye in the Cohort 1 population), 1 case of cap malalignment (repositioned without sequelae), 1 retinal detachment in each Cohort, and several early cataracts. The retinal detachments occurred at 11 months and >1 year postoperatively, indicating that these detachments were unrelated to surgery. The early cataracts were noted prior to surgery and were not induced. There were no corneal infections, lost or melted caps, or retinal vascular accidents recorded.

- Complications

  Corneal edema was noted between 1 week and 1 month in 5.3% of the Cohort 1 population and 3.4% of the Cohort 2 population. These cases resolved with further healing. The following complications - transient corneal central and peripheral epithelial defects, epithelium in the

central interface that required removal, aborted procedures due to an incomplete cap, and cap striae - each occurred with ≤ 1% incidence. Epithelium in the periphery, which did not influence vision and did not require removal, occurred somewhat more frequently in the Cohort 1 population, as compared with the Cohort 2 population. Hingeless flap, an intraoperative complication, occurred in 1.8% of cases in the Cohort 1 population and 0.7% of cases in the Cohort 2 population. There were no associated sequelae with a hingeless flap. Interface foreign bodies at each interval which were observed under slit-lamp, but had no clinical sequelae, ranged between 14.5% and 8.8%.

In addition, glare, halos, trouble with night driving, double vision/ghosting, foreign body sensation, and anxiety, and pain were also reported. The incidence of these events considered by patients to be bothersome ranged from 0% to 4.1% for both protocol populations. Difficulty with night driving that was of a bothersome nature occurred at a rate of 4.1% in the Cohort 1 population and 1.1% in Cohort 2. Events of a similar nature, but not considered bothersome by the patients, occurred at a somewhat higher incidence.

All of these events tended to be less prevalent in Cohort 2 than in the earlier Cohort 1, likely because of improvements in centering strategy and surgical technique. As expected, these events were also less prevalent in the <7 D group as compared with the ≥7 D group in both protocol populations. Eyes with residual refractive errors also had a higher incidence than those with SEs within ±0.5 D. The study did not measure the extent to which the events may have resolved in the presence of spectacle correction, as would be expected.

C. STUDY PERIOD AND INVESTIGATIONAL SITE

Study design

This was a prospective, non-randomized, unmasked, single-center clinical with the participants acting as their own controls. Surgery was performed by two physicians.

Study period

A total of 2,482 eyes were treated under both protocols, beginning on May 1, 1993. The database was closed for purposes of this analysis on November 20, 1997.

Investigational site

All procedures were performed at the Kremer Laser Eye Center. Patients were evaluated postoperatively at the Kremer Laser Eye Center and at co-managing sites, provided the referring caregiver was qualified as a co-managing investigator.

D. Data Analysis and Results

Key efficacy variables

Table 3 presents a summary of efficacy results at the 6-and 12-month visits, stratified by protocol, for eyes having one or more LASIK treatments. Six-month UCVA was 20/40 or better in 88.4% of all eyes after the final LASIK treatment, and 84.1% following initial treatment only without regard to further enhancement. When the 6-month UCVA results were compared between Cohorts 1 and 2, there was a statistically significant between-group difference. A greater proportion of eyes in the Cohort 2 population had UCVA of 20/40 or better and 20/20 or better. This is due to the intentional undercorrection performed in some of the Cohort 1 eyes. None of the other efficacy variables were significantly different when the two populations were compared.

Table 3 . Summary of Key Efficacy Results After Final[1] Treatment at 6 and 12 Months

	Cohort 2 (%)		Cohort 1 (%)		
Efficacy Variable	6 months	12 months	6 months	12 months	P value[2]
UCVA:[3]					
20/20 or better	199/491 (40.5)	87/218 (39.9)	212/668 (31.7)	202/612 (32.7)	0.840
20/40 or better	446/491 (90.3)	201/218 (92.2)	579/668 (86.7)	535/612 (87.4)	0.523
MRSE:[4]					
±0.5 D	472/665 (71.0)	199/269 (74.0)	494/737 (67.0)	431/688 (62.6)	0.401
±1 D	584/665 (87.8)	249/269 (92.6)	631/737 (85.6)	588/688 (85.5)	0.231
±2 D	650/665 (97.7)	266/269 (98.9)	710/737 (96.3)	669/688 (97.2)	0.091

1. Final treatment includes all eyes treated after their last LASIK procedure.
2. Cochran-Mantel-Haenszel statistic comparing 6 and 12 months, controlling for protocol.
3. All eyes treated for monovision were excluded from this analysis, since undercorrection is intentional in this sub-population
4. Manifest refraction spherical equivalent.

There was a statistically significant difference between all key efficacy variables when eyes with preoperative SE <7 D were compared with those with preoperative SE ≥7 D, thus indicating that the LASIK procedure produced better results in eyes with low- to moderate preoperative myopia. Table 4 summarizes the key efficacy variables and statistical comparisons for patient eyes after their final LASIK treatment.

Table 4. Summary of Key Efficacy Results After Final[1] Treatment at 6 Months Stratified by Preoperative SE

	Cohort 2 (%)		Cohort 1 (%)		
Efficacy Variable	<7 D	≥7 D	<7 D	≥7 D	P value[2]
UCVA:[3]					
20/20 or better	185/371 (49.9)	14/120 (11.7)	176/447 (39.4)	36/221 (16.3)	0.001
20/40 or better	358/371 (96.5)	88/120 (73.3)	407/447 (91.1)	172/221 (77.8)	0.001
MRSE:[4]					
±0.5 D	374/477 (78.4)	98/188 (52.1)	356/483 (73.7)	138/254 (54.3)	0.001
±1 D	446/477 (93.5)	138/188 (73.4)	439/483 (90.9)	192/254 (75.6)	0.001
±2 D	475/477 (99.6)	175/188 (93.1)	480/483 (99.4)	230/254 (90.6)	0.001

1. Final treatment includes all eyes treated after their last LASIK procedure.
2. Cochran-Mantel-Haenszel statistic comparing preoperative SE (<7D vs. ≥7D), controlling for protocol.
3. All eyes treated for monovision were excluded from this analysis, since undercorrection is intentional in this sub-population.
4. Manifest refraction spherical equivalent.

Table 5 summarizes the key efficacy variables and statistical comparisons for myopic eyes versus myopic astigmatic eyes at 6-months after the final LASIK treatment in Cohort 2. When controlling for high vs. low myopia, a comparison of efficacy results between eyes treated for myopia only and eyes treated for both myopia and astigmatism showed no statistically significant differences, with the lone exception being a reduction in the number of high myopic astigmatic eyes achieving UCVA of 20/20 or better.

Table 5. Summary of Key Efficacy Results[1] at 6 Months Stratified by Spherical vs. Astigmatic Myopia Controlling for Preoperative SER

	< 7 D		> 7 D		
Efficacy Variable	Spherical Myopia	Astigmatic Myopia	Spherical Myopia	Astigmatic Myopia	P value[2]
UCVA:[3]					
20/20 or better	111/213 (52.1)	74/158 (46.8)	12/61 (19.7) 47/61 (77.1)	2/59 (3.4)	0.057
20/40 or better	204/213 (95.8)	154/158 (97.5)		41/59 (69.5)	0.808
MRSE:[4]					
±0.5 D	192/243 (79.0)	182/234 (77.8)	36/76 (47.4) 52/76 (68.4)	62/112 (55.4)	0.703
±1 D	228/243 (93.8)	218/234 (93.2)	68/76 (89.5)	86/112 (76.8)	0.456
±2 D	242/243 (99.6)	233/234 (99.6)		107/113 (95.4)	0.141

1. Includes all eyes in Cohort 2 after the last LASIK treatment.
2. Cochran-Mantel-Haenszel statistic comparing spherical and astigmatic myopia, controlling for Preoperative SER group.
3. All eyes treated for monovision were excluded from this analysis, since undercorrection is intentional in this sub-population.
4. Manifest refraction spherical equivalent.

Other efficacy results after final LASIK treatment:

Additional efficacy measures are summarized below.

- Stability of manifest refraction.

  A total of 451 eyes were examined at three (3) consecutive visits (1, 3 & 6 months) in Cohort 2, of which 89.3% achieved stability (defined as a change in SE of ≤1.00 D across consecutive visits) between the month-1 and month-3 visits, increasing to 93.3% stability between the 3-month and 6-month visits. When analyzing those eyes evaluated at all four (4) consecutive visits in Cohort 2, (n = 139) 90.6% achieved stability between the 1- and 3-month visits, 95.0% between the 3- and 6-month visits, and 96.4% between the 6- and 12-month visits.

- Accuracy of sphere and cylinder for astigmatic myopes.

  Sphere. For all eyes treated in Cohort 2 , mean intended spherical correction was -4.95 D and mean actual correction at the sixth postoperative month was -4.94 D. For eyes treated in Cohort 1, mean intended spherical correction was -5.58 D and mean actual correction at month 6 was -5.34 D.

Over 80% of those eyes treated for myopic astigmatism achieved correction within ±1 D of intended sphere at 1 month. This level of accuracy was maintained throughout the 1-year study period.

Cylinder. Over 80% of all eyes treated for myopic astigmatism achieved cylinder correction within ±1 D of zero cylinder at 1 month. This level of accuracy was maintained throughout the 1-year study period. For myopic astigmatism, there was a mean undercorrection of just 0.1 D in Cohort 2. The procedure most effectively reduced cylinder magnitude in eyes with >1 D preoperative cylinder. Table 6 presents the accuracy of cylinder correction (to zero) for eyes in Cohort 2, stratified by high versus low dioptric group.

Table 6. Accuracy of Cylinder Correction (to Zero) for Eyes Treated in Cohort 2

Sphere	Preoperative SER[1] < -7 D			
	1 Month n/N (%)	3 Months n/N (%)	6 Months n/N (%)	12 Months n/N (%)
≤ 0.50 D	252/365 (69.0)	208/327 (63.6)	153/234 (65.4)	63/95 (66.3)
≤ 1.00 D	329/365 (90.1)	287/327 (87.8)	209/234 (89.3)	84/95 (88.4)
Sphere	Preoperative SER > -7 D			
	1 Month n/N (%)	3 Months n/N (%)	6 Months n/N (%)	12 Months n/N (%)
≤ 0.50 D	58/149 (38.9)	53/135 (39.3)	43/112 (38.4)	18/43 (41.9)
≤ 1.00 D	105/149 (70.5)	94/135 (69.9)	77/112 (68.8)	25/43 (58.1)

1. Spherical Equivalent Refraction.

- Stability of cylinder.

  The manifest cylinder refraction was considered stable when cylinder did not change by more than 1 D between any two postoperative visits. Stability of cylinder was achieved in approximately 93.5% of all eyes between the month 1 and 3 visits, increasing to 94.7% between the 3 and 6 month visits, and 95.5% had a stable cylinder between 6 and 12 months.

Key safety variables

Table 7 presents a summary of key safety variables for all eyes after their final LASIK treatment at the 6- and 12-month visits, stratified by protocol. The overall proportion of eyes for both studies combined losing ≥2 lines of BSCVA at 12-months was ≤2.3% after final LASIK treatment, and 1.4% after initial LASIK treatment. When these key safety results are compared between Cohorts 1 and 2, there are no statistically significant differences.

Table 7. Summary of Key Safety Results After Final[1] Treatment at 6 and 12 Months

	Cohort 2 (%)		Cohort 1 (%)		
Safety Variable	6 months	12 months	6 months	12 months	P value[2]
BSCVA:					
Loss of >2 lines	14/665 (2.1)	2/269 (0.7)	20/737 (2.7)	20/688 (2.9)	0.593
Worse than 20/40	4/665 (0.6)	3/269 (1.1)	11/737 (1.5)	12/688 (1.7)	0.480
Worse than 20/25 with 20/20 or better preop	26/665 (3.9)	10/269 (3.7)	33/737 (4.5)	28/688 (4.1)	0.696
Increase of >2D cylinder[3]	2/319 (0.6)	2/131 (1.5)	1/315 (0.3)	2/283 (0.7)	0.258

1. Final treatment includes all eyes treated after their last LASIK procedure.
2. Cochran-Mantel-Haenszel statistic comparing 6 and 12 months, controlling for protocol.
3. Eyes treated for spherical correction only.

There was a statistically significant difference in favor of SE <7 D in several of the key safety variables when eyes with preoperative SE <7 D were compared with those with preoperative SE ≥7 D. Table 8 summarizes the key safety variables and statistical comparisons for patient eyes after final LASIK treatment.

Table 8. Summary of Key Safety Variables After Final[1] Treatment at 6 Months Stratified by Preoperative SE

	Cohort 2 (%)		Cohort 1 (%)		
Safety Variable	<7 D	≥7 D	<7 D	≥7 D	P value[2]
BSCVA:					
Loss of >2 lines	2/477 (0.4)	12/188 (6.3)	2/483 (0.4)	18/254 (7.1)	0.001
Worse than 20/40	1/477 (0.2)	3/188 (1.6)	0/483 (0)	11/254 (4.3)	0.001
Worse than 20/25 with 20/20 or better preop	9/477 (2.0)	17/188 (9.0)	8/469 (2.0)	17/183 (9.0)	0.001
Increase of >2D cylinder[3]	0/243 (0)	2/76 (2.6)	0/252 (0)	1/63 (1.6)	0.001

1. Final treatment includes all eyes treated after their last LASIK procedure.Cochran-Mantel-Haenszel statistic comparing preoperative SE (<7D vs. ≥7D), controlling for protocol.
2. Eyes treated for spherical correction only.

Other safety results after final LASIK treatment

- Residual cylinder.

  Both the Cohort 2 and Cohort 1 populations had slight cylindrical overcorrections when the intended correction was taken into consideration (mean overcorrections: 0.18 D and 0.21 D, respectively). These overcorrections, or surgically induced residual astigmatism, were greater in eyes treated for myopia only. The mean cylinder overcorrection was approximately one-half of a diopter among eyes treated for myopia only in both populations.

  Of eyes treated for myopic astigmatism, 68.8% of those treated in Cohort 2 and 70.9% of those treated in Cohort 1 had residual cylinder <1 D at the point of stability (6 months postoperatively). The number of these eyes with residual cylinder >2 D is low (n=15/346 for the Cohort 2 population and n=21/422 for the Cohort 1 population). Table 11 summarizes the residual astigmatic error observed at 6-months postoperatively in eyes treated for astigmatic myopia.

- Change in cylinder axis

  The median shift in cylinder axis among all eyes treated was 25° for the Cohort 2 population and 35° for the Cohort 1 population. The highest shifts in astigmatic axes tended to occur in eyes with the lowest degrees of residual cylinder. A shift in axis has no clinical significance, and is analogous to a compass needle showing multiple directions at the North Pole. .

Retreatments

In Cohort 2 , 47 eyes were retreated for undercorrection, for an overall enhancement rate of 3.5% (n=47/1342) under this protocol. This retreatment rate compares very favorably with those cited in the literature for other refractive procedures. From 6% to 10% or more of eyes that undergo surface photorefractive keratectomy require at least one enhancement, and retreatment rates for radial keratotomy procedures run as high as 30%.

In Cohort 1 , 162 eyes were retreated for undercorrection, for an overall enhancement rate of 14.2% (n=162/1140). The higher retreatment rate in this earlier population is attributable to the earlier Cohort 1 protocol requirement of intentional undercorrection. Four (4) retreated eyes had a decrease of BSCVA greater than 2 lines at 3-months which persisted out to 12-months postoperatively.

Most key efficacy and safety variables differed significantly between eyes that received one (1) treatment and eyes that received two (2) or more treatments.

V. PRE-OPERATIVE EXAMINATION AND SURGICAL PLANNING

Ocular Examination and History

A. HISTORY

Complete ocular and medical histories are obtained from the patient including primary reason for desiring the evaluation, patient's occupation, hobbies or activities patient enjoys. Work requirements on a visual basis, previous ocular history including the role of previous ocular injuries, ocular infections or previous ocular surgery. Contact lens history is taken detailing type of previous contact lens wear, how long the patient has continuously been wearing contact lenses and when the lenses were last worn, as well as documentation of absence or presence of contact lens intolerance or other complications. Complete medical history is obtained with specific rule outs for hypertension, heart/lung or breathing problems, thyroid or kidney problems or diabetes mellitus. Complete medical evaluation for pharmaceutical agents is reviewed as well as any known allergies to medications.

B. VISUAL ACUITY MEASUREMENTS

The patient is seated at 6 optical meters distance from the acuity chart. A standard occluder is held by the patient to block out the eye not being tested and the examiner must constantly ensure that the untested eye is completely covered to avoid inadvertent peeking. The patient is instructed to read the smallest line on the chart that is easily visible. This saves the monotonous reading of the entire chart.

When the patient cannot read a letter they are encouraged to guess at it. If the patient states that the letter is one of two letters, they are asked to choose only one letter, and if necessary, to guess. The patient may neither squint to achieve pinhole nor lean forward.

Visual Acuity and Refraction will be performed with the Snellen Eye Charts. Please refer to the Patient Data Collection Chart which describes at which visits Visual Acuity and Refraction are required on the operative eye (or both eyes at certain designated visits).

C. METHOD OF REFRACTION

The trial frame or phoropter is placed and adjusted in front of the patient's face so that the lens cells are parallel to the anterior plane of the orbits and centered in front of the pupils. Manifest retinoscopy is performed to obtain initial objective refraction prior to beginning subjective refraction. The left eye is occluded and subjective refraction begun on the right eye.

The patient is then asked to look at and read a Snellen acuity chart in the light box at an optical distance of 6 meters either directly or with a mirror.

Each refraction should be done without knowledge of the previous refraction results.

The refraction should be performed until neither the power nor the axis of the cylinder can be improved. The power of the sphere is rechecked by adding +0.37 and -0.37 spheres and changing the spherical power by quarter diopter increments of the appropriate sign until the patient can perceive no improvement in vision. If the sphere is changed at this point, the cylinder should be rechecked. This process is repeated until no further significant lens changes are made. The lens corrections obtained in this way for the right eye are recorded. The entire process is repeated for the left eye and the lens corrections are recorded on the examination form.

D. BRIGHTNESS ACUITY TESTING (BAT)

This test is commonly referred to as glare testing. Currently BAT testing is being performed with a Mentor Brightness Acuity Testor. Performance of brightness acuity testing is being performed as described in the instructions found within the Operating Manual. (See Fig. 1) Brightness Acuity Testing is also performed at subsequent follow up visits until stabilization of vision, at which time results of brightness acuity testing pre- and post-operatively can be compared within our data analysis.

E. CYCLOPLEGIC REFRACTION

For Cycloplegic Refraction, Retinoscopy and Refraction are carried out as described above in the Section "Manifest Refraction". Cycloplegia is obtained by instilling 1 drop of 1% Mydriacyl in each eye, three times each separated by 5 minutes. Cycloplegic refraction is performed 30 to 45 minutes after the last instillation of 1% Mydriacyl.

F. CONTRAST SENSITIVITY - OPTIONAL

Contrast sensitivity is performed on both eyes with best corrected visual acuity (BCVA) with and without the BAT.

Contrast sensitivity is current being measured with a vector vision CSV 1000 Contrast Sensitivity Unit and is being performed as described in the Operations Manual.

G. NATURAL PUPIL

Pupil examination is performed at pre-op, 12 month, and 2 year intervals, or as needed based on symptoms from the patient or signs found within the clinical examination. Pupil findings are recorded on the chart in the standard PERRLA format, as well as scotopic and photopic pupil measured diameters are recorded.

H. STABILITY OF CONTACT LENS WEARERS

All patients who wear contact lenses will be asked to discontinue wearing them prior to LASER-K^{SM} LASIK refractive evaluation and to continue absence of lens wearing prior to any surgical treatment.

- Soft lenses - discontinue wear for minimum of 2 weeks

- Hard lenses - (including PMMA and all rigid gas permeable materials) discontinue wear for a minimum of 3 weeks

Review contact lens history with patient including total time wearing contact lenses, when last worn, and type of lenses worn, any complications with contact lens wear recorded.

I. INTRAOCULAR PRESSURE

For measurement of intraocular pressure Goldmann Applanation Tonometry is performed after instillation of 1 drop 0.5% Proparacaine and application of fluorescein.

J. CORNEAL TOPOGRAPHY

Corneal mapping is performed with the Tomey TMS-1 corneal topography unit as described in the Operations Manual.

K. CORNEAL THICKNESS TESTING

Corneal thickness testing is performed with the Accutome Corneometer (ultrasound pachymetry) as described in the Operations Manual.

L. BIOMICROSCOPY

A slit lamp examination of the cornea (operative eye/s) will be carried out at least every visit as part of a thorough ocular examination. The corneal cap will be evaluated for clarity and integrity at every visit, with and without fluorescein staining.

A detailed evaluation of the cornea in terms of the presence of haze will be performed.

Visual Diagram: (Optional) To assist in describing a patient's haze, a circle symbolizing the cornea (limbus to limbus) will be included on the Post-operative Report to allow the clinical investigator to include information regarding the location and extent of the haze. Please refer to the Clinical Evaluation forms included at the end of this Section.

Summary of Pre-operative report includes detailed discussion involving refractive options for the patient including contact lenses, spectacle lenses, refractive surgeries involving LASER-K^{SM}LASIK ALK, HLK, PRK, PTK, CGK, keratophakia or other procedures that may be available to the patient on a case-specific basis.

Patients are given the option of having LASER-K^{SM} LASIK performed on one eye or bilaterally.

M. PATIENT INSTRUCTIONS

Pre-operative

Pre-operative LASER-K[SM] LASIK patients are notified the day prior to surgery to review pre-operative instructions. Pre-operative instructions include the following:

1. No food after midnight.
2. May have clear liquids up to 2 hours prior to arrival.
3. Patients are to take regular medication prior to arrival
4. Patient is instructed to shower, shampoo hair, and wash face with DIAL soap the morning of surgery.
5. Verify telephone number where patient may be reached evening of surgery for post-surgical follow-up call.
6. Name and telephone number of person to contact in case of emergency.
7. One day post-operative appointment given to patient.

N. PATIENT INSTRUCTIONS/PROCEDURES

Day of Surgery

The patient arrives at the Surgery Center at the designated time. He/she is asked to sign in at the front desk. At this time additional pre-operative testing is performed (i.e., repeat manifest refraction, corneal topography, etc.) if needed. Office staff then notifies the pre-operative area that the patient is ready. A transporter then assists patient to the pre-operative area with their office and surgical charts.

Once the patient arrives in the pre-operative area, they are assisted to a pre-operative lounge chair and identity is established along with surgical procedure and verified by nursing personnel. The Informed Consent is then given to the patient to read and, if they cannot read it, it is read to them by one of the nursing personnel. After the patient has read the Informed Consent, they are asked to sign it and the nursing personnel will witness their signature. If the patient has questions at this point, they are taken to a private exam room where they will see the surgeon and have their questions answered prior to signing the Informed Consent. Following the Informed Consent process, the patient is given the post-operative instructions form, they are asked to read and sign the form (the patient is given a copy of this form upon discharge). The patient is then asked to read and sign a General Surgical Consent form which lists the exact surgical procedure to be performed, with the designated eye or eyes, and the surgeon performing the procedure. Following the Consent process, the patient is asked to complete a review of medical systems questionnaire to aid us in assessing their general health. Finally they are given a Patient Bill of Rights form to read and sign. The patient is given a copy of this form upon discharge.

The pre-operative LASER-K[SM] LASIK patient is then asked to change into a disposable surgical jump suit that is worn over their street clothes and they are given shoe covers and a hair bonnet.

This is a precaution to maintain sterile conditions in the Operative Suite. Personal effects are placed in a storage bag with the patient's name on it. A name tag with the procedure and eye(s) is then placed on the patient's jump suit. Identification stickers are placed over eye or eyes for verification. Next, the nurse will verify known allergies to medications with the patient and a drug allergy label is then applied to the patient's jump suit. If the patient has a known allergy to one of the medications used pre-, peri- or post-operatively, the surgeon is notified at once and a medication change is implemented. Allergy labels are then placed on the outside of both surgical and office charts (upper right hand corner) and in the appropriate places inside the charts (on the surgical form). Vital signs are taken and recorded. These include temperature, pulse, respirations, blood pressure and oximetry. Pre-operative sedation is given 45 to 60 minutes prior to procedure. The pre-operative sedation includes Ansaid 100 mg po and Halcion 0.125 mg sublingually. The patient is made comfortable in the lounge chair and offered a blanket if needed.

VI. LASER-K^{SM} LASIK PROCEDURE FOR MYOPIA AND/OR ASTIGMATISM

Note: Before proceeding, please review the Operator Instruction Manual.

A. ENTERING PATIENT DATA

The LASER K^{SM} procedure for correction of myopia is prefaced with careful review of the patient's medical record. Once the plan of correction has been established, the surgeon will instruct the Laser Technician in how the refractive data will be entered into the "Excimer Operative Computer Program". The technician enters the appropriate refractive data consisting of the following:

Name
Date
Type of procedure
Eye
Central corneal thickness
Pupil diameter (photopic and scotopic)
Refraction
Vertex distance
Desired final refraction.

The program will then calculate the diopters of correction to be placed at the corneal plane.

Procedures for the correction of myopia may require the amount of myopic correction to be divided into more than one component. The total diopters of correction (obtained from the patient's medical record) placed in one component is 4.00 diopters. If the total amount of correction is above four diopters, then more than one component will be used.

B. COMPONENTS OF MYOPIC CORRECTION

In some cases, the amount of myopic correction may require more than one component. The maximum diopters of myopia corrected in one component is 4.00 diopters. This number is taken from the patient's refraction in minus cylinder. For example:

- 4.00 - 1.00 x 180

If the spherical portion of the refraction (in minus cylinder) is greater than 4, then more than one component will be used. To determine the number of components to be used, just look at the "Factored Correction" found on the Excimer Operative Computer Program. If the spherical portion of the correction is greater than 4 D (e.g. 6.50 D), then divide that number by 2, and ablation is done in two components. For example:

$$\frac{\{6.50\}}{2} - 1.00 \text{ @ } 180$$

and

$$\frac{\{6.50\}}{2} = 3.25$$

The spherical correction would consist of two equal components of -3.25. If the spherical diopters of correction divided by 2 is greater than 4.00 diopters, then three components are to be used.

For example:

Incorrect: $\frac{(9.00)}{2} = 4.50$ (greater than 4.00)

Correct: $\frac{(9.00)}{3} = 3.00$ (less than 4.00)

In this case, there would be three components consisting of -3.00 diopters of correction in each component for a total correction of 9.00 diopters.

This information is then entered into the Excimer laser computer under the program for myopia correction. The following information is then entered:

Diopters of correction (-3.00)
Starting iris diameter (1.0 mm)
Final iris diameter (6.0 mm)
Number of pulse intervals (120)
Number of Hertz (10).

The Excimer laser computer will then calculate the total number of pulses and total microns of tissue to be ablated. The laser technician then records this information on the Excimer Operative Computer Program data sheet as the patient's control numbers.

To perform astigmatic correction, enter the program for Astigmatic correction on the Excimer Laser and enter the following information:

Diopters of correction (as determined from refraction)
Angle of correction (as determined from patient position and refraction)
Starting slot diameter (1.0 mm)
Final slot diameter (6.0 mm)
Slot intervals (maximum listed on screen)
Starting iris diameter (6.0 mm)
Final iris diameter (6.5 mm)
Iris intervals (21)
Fire laser at 10 Hertz.

The computer will then calculate the total microns of tissue to be ablated in a total number of pulses. Record this information on the patient data sheet. Place test paper under delivery system of Excimer laser and allow one pulse to be emitted. This is to ensure correct alignment of slot angle. In turn, during the course of the procedure, the laser technician will double check the pulses and total microns listed on the computer screen against the control numbers, to ensure the information had been entered correctly. The surgeon is then seated at the head of the operating room table and with the patient lying supine on the operating table, the height of the table is adjusted to bring the cornea to the level of the crossed HeNe beam. This is done under the highest magnification of the microscope, at the same time centering of the eye under the microscope is checked by ensuring that the cornea is appropriately located within the field of view of the microscope (patient fixating on co-axial light).

C. MARKING THE CORNEA

A 6 mm corneal marker is then pressed into a methylene blue sponge and a circular mark is placed on the temporal corneal limbal area. This should be placed so that the microkeratome will bisect approximately half the circle when the flap is made. At this point, balanced salt solution is irrigated over the surface of the eye and excess balanced salt solution is removed via suction tubing.

D. USING THE MICROKERATOME

The microkeratome is then brought into the field. The suction ring is placed onto the globe, decentered nasally approximately 0.50 to 1.0 mm. The foot pedal controlling the suction power supply unit is then depressed, activating the suction ring. Proper functioning of the suction ring at this point is verified in two ways: first, by a change in the pitch of the sound being emitted by the suction device, and second, by inserting mild upward pressure on the ring to ensure proper suction. Next, install the shaper head of the microkeratome onto the suction ring by engaging the dovetail

side first, then rotate the shaper flat against the ring. Gently advance the shaper until the gears are engaged. Central placement of the microkeratome is checked by placing gentle upward pressure to be sure that both the foot plates are well seated. The microkeratome is then passed forward by depressing the forward foot switch, creating the corneal flap. When the stop is reached the foot pedal is released and again, the foot pedal which activates the forward direction of the microkeratome movement is tapped to ensure that the microkeratome has transversed the entire length of the tracks.

The microkeratome is then run in the reverse direction and, as soon as it reaches the end of the suction ring, the microkeratome is removed from the suction ring. The suction ring is immediately removed from the eye after suction has been broken and the cornea is inspected to ensure that the flap has been created properly, that the flap is indeed in place and has not become a cap which is still contained within the microkeratome.

E. COMPLETING LASER APPLICATION

A "T" forceps is then used to retract the flap onto the medial canthal area after the medial conjunctival and medial canthus have been dried thoroughly with a Weck cell sponge. The flap is smoothed using a Weck cell sponge and the microscope is placed on full zoom. Again, proper positioning is checked to ensure the pupil is directly in the center of the microscope field and with the HeNe beams aligned, the laser procedure continues.

The surgeon then verifies that the appropriate data have been entered into the computer and that the Excimer laser is ready for ablation. At this point, the laser technician will open the laser port and the surgeon will then depress the foot pedal controlling the Excimer laser. If more than one myopic application is to be applied, the second and/or third components will follow consecutively. At the end of the laser application(s), the stromal bed is irrigated with balanced salt solution and excess balanced salt solution is removed again, using suction tubing.

The flap is repositioned by gently pushing the flap back into position using the irrigating tip of the balanced salt solution bottle. The sphere edge of the flap is gently lifted and a space between the flap and the stromal bed is freely irrigated with copious amounts of balanced salt solution. At this time, flap positioning is checked using the pre-placed methylene blue marker, as well as checking to see that the distance between the flap and the surrounding corneal tissue is equal for 360 degrees. While dripping balanced salt solution on the center of the cornea, oxygen is directed at the cap interface using a 21 gauge anterior chamber cannula on the end of the oxygen tubing to thoroughly dry the epithelial junction between the corneal flap and the peripheral cornea. The flow of oxygen is applied starting at the hinged side of the flap and moving progressively towards the opposite side. This ensures that the edge of the flap will not be blown or lifted up during the drying process. Once the corneal junction is thoroughly dry, a forceps is used to check the adherence of the flap to the underlying stroma by gently pressing on both the corneal flap and the surrounding corneal tissue sides to be sure that the flap is adherent.

The lid speculum is removed and the patient is asked to blink several times. The eye is then reopened and the flap checked to be sure the edges have not moved and the flap is intact.

A drop of Maxitrol ophthalmic solution is then placed in the eye and attention is turned to the opposite eye if a bilateral procedure is specified. An identical procedure is carried out with the opposite eye after which the first eye is again checked for cap position. A shield is placed over the patient's eye(s) and the patient is taken to the recovery room.

F. LASER-K[SM] LASIK PATIENT INSTRUCTIONS/PROCEDURES

Post-operative

Following completion of the LASER-Ksm LASIK procedure, Maxitrol ophthalmic solution is instilled in one or both eyes depending on the procedure(s) performed, unilaterally or bilaterally. Clear shields are taped over the eye(s) and the patient is escorted to the recovery room via wheelchair. Once the patient has been received in the post-operative area, he/she is seated in a reclining chair and given his/her post-operative nourishment.

The post-operative instructions are then reviewed with the patient by the recovery room nurse. The patient is discharged with instructions to go home and lie quietly in a darkened room and to keep both eyes closed as much as possible. However, he/she is allowed to open his/her eyes to ambulate to the rest room.

The patient is given two prescriptions for eye drops. These include Pred Forte 1% ophthalmic solution, 1 drop in the operative eye(s) b.i.d. for 4 days and then discontinue and Tobrex ophthalmic solution 1 drop in the operative eye(s) q.i.d. for 4 days and then discontinue. The patient is instructed to bring the drops with him/her the next day for the one-day postoperative visit. He/she is to keep the shields in place until their postoperative visit. A patient with greater than 5 diopters of myopia is given prescriptions for Darvocet N-100 1 tablet p.o. q 4 hours prn for pain and Demerol 50 mg 1 tablet p.o. q 4 hours prn for pain. A patient with less than 5 diopters of myopia is given a prescription for Darvocet N-100 1 tablet p.o. q 4 hours prn for pain.

G. LASER SURGICAL PROCEDURES

1. Turn the power on.
2. Check power levels and calibrate the laser as described in Section I of the Kremer Excimer Laser Serial No. KEA940202 Operator Instruction Manual (Document KEA0100). Note: recheck calibration with a film test firing and a -2.00 diopter plastic test firing after every fifth patient.
3. Check to be sure that the microscope zoom and focus are operating properly.
4. Be sure that the HeNe beam is on and operating properly.
5. Turn on video recorder and monitor.
6. Bring patient into the room and place them on the chair with their head under the operating microscope. Position the patient so that the microscope light and the HeNe

beam are both centered over the right eye of the patient. Test the lateral movement of the chair to be sure that the left eye can be accessed for the second half of the treatment without difficulty.

7. Prep the patient's eyelid skin with a small amount of iodine, being sure not to get any iodine into the eyes. When the iodine has dried, place a plastic adhesive drape over the patient's face with both eyes cut out.
8. Instill Tetracaine drops in the eye and place a lid speculum between the lids of the right eye.
9. Raise the table so that the patient's eye is in good focus in the microscope and so that the HeNe beams line up over the center of the pupil.
10. Have the patient fixate directly onto the microscope light and zoom the microscope to full power and note the position of the surgical limbus in relation to the microscope field, and use the relationship between the limbus and the microscope field to ensure proper alignment throughout the procedure.
11. Once proper positioning is assured, reduce zoom, place a semicircle with a 4 mm radial keratotomy optical zone marker saturated with Gentian violet over the temporal half of the cornea, to insure proper cap repositioning.
12. Rinse the corneal surface thoroughly with balanced salt solution to remove any debris.
13. Check the surgical plan with the surgical parameters entered into the computer. If astigmatic treatment is involved, check the angle of the astigmatic treatment to be used with thermal paper just prior to the start of the procedure.
14. When the surgical plan and the astigmatic angle have been confirmed, place the suction ring on the patient's eye and confirm a good seal with a slight upper pull.
15. Make a pass with the microkeratome creating the corneal flap.
16. Dry the nasal conjunctiva and using a T forceps, swing the flap and lay it over the nasal conjunctival area, being sure that the hinge is well out of the surgical field.
17. Using a Weck sponge dry the area of the hinge, zoom to full power, center the patient's eye and encourage the patient to maintain the fixation throughout the procedure.
18. While continually monitoring fixation, place the astigmatic treatment first followed by all myopic treatment components.
19. At the conclusion of the laser treatment use balanced salt solution to vigorously clean the stromal bed upon which the laser treatment was applied. Also moisten both the surface and the underside of the cap.
20. When all the debris have been removed from the stromal bed, use the nozzle of the balanced salt solution cannula to lay the corneal flap back onto the stromal bed. Position it using the pre-placed marks and squeegee all of the balanced salt solution from the cap-stroma interface by sweeping with a tying forceps from nasal to temporal on the flap.
21. While keeping the center of the cornea moistened with balanced salt solution, use a moderate flow of oxygen through an 18 gauge cannula to dry the edge of the flap-stromal interface.
22. When complete drying has been achieved, use a tying forceps to apply light pressure outside the flap edge on the cornea to be sure that striae go from the area of pressure onto the cap. This ensures that the cap is well sealed.

23. Remove the speculum, have the patient blink several times to ensure that the flap is well sealed into position. Apply a drop of Maxitrol and repeat the procedure for the left eye.
24. At the end of the left eye treatment, recheck both the right and left eye again to be sure that the flap is in good position.
25. Place shields over both eyes and take the patient back to the recovery room where they should be checked again at the slit lamp before leaving the Center.
26. While in the recovery room, postoperative instructions should be reviewed in detail and any prescriptions should be reviewed with the patient at this time.

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Patient Information on the LASER-K^{SM} Surgery

(LASIK)

Please speak with your doctor regarding the LASER-K^{SM} process for the correction of myopia (nearsightedness) with or without astigmatism.
Use of any machine for a medical treatment
requires discussion with a doctor.
It is important for you to read this booklet and
then discuss its contents in detail with your doctor.

LASER-K^{SM} is used to treat degrees of nearsightedness between -1.00 and -15.00 diopters with or without astigmatism up to 5.00 diopters.

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Table of Contents

Introduction

We have prepared this booklet to help you make an informed decision about having LASER-K℠ eye surgery. LASER-K℠ is an abbreviation for Laser Keratomileusis. It is one form of Laser Assisted Intrastromal Keratomileusis (LASIK), developed at the Kremer Laser Eye Center.

Please take as much time as you wish to review this booklet before making your decision to have surgery. You may decide not to make any decision at this time. We welcome any questions you may have after reading this booklet.

61

How The Eye Works

In a normal eye, light focuses on the retina (the back of the eye). This allows you to see a clear image.

If light is focused in front of or behind the back of the eye, it is referred to as a refractive error. Listed below are types of refractive errors.

- Myopia or nearsightedness is caused by light focusing in front of the back of the eye. Most nearsighted people can see close, but far objects seem blurry.

- Astigmatism causes light to be focused at two points. It may exist by itself or with nearsightedness. This may cause you to see objects blurry or double at distance and close up.

What Is LASER-K℠?

LASER-K℠ is a surgical procedure for correcting nearsightedness and astigmatism. An excimer laser reshapes the cornea so that light can focus on the back of the eye.

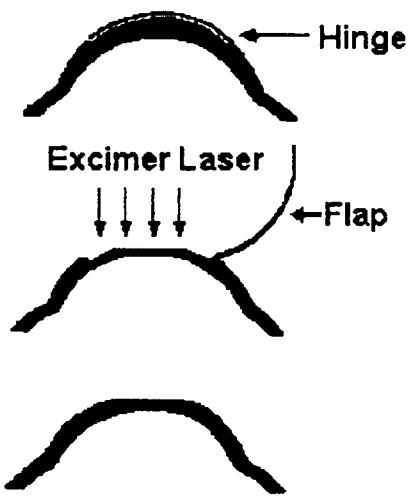
LASER-K℠ is used to treat degrees of nearsightedness between -1.00 and -15.00 diopters with or without astigmatism. Your vision should be at least -1.00 diopter of nearsightedness (very mild) or greater. (A diopter is a unit used to measure the amount of nearsightedness and/or astigmatism.)

What Is An Excimer Laser?

An excimer laser is a laser which removes very thin layers of corneal cells without damaging nearby layers. (The cornea is the clear surface over the colored part of the eye.)

A computer program controls the laser by telling it how much tissue to remove to correct a given refractive error. The program was written at the Kremer Laser Eye Center specifically for the LASER-K℠ process.

How Is LASER-K℠ Performed?



The LASER-K℠ process uses an excimer laser under the surface of the cornea. The doctor saves the surface cells by folding them to one side. The doctor uses a device called a microkeratome to create a 'flap' of the surface cells. The excimer laser reshapes the cornea by removing very thin layers of the underlying cells. Next, the flap is put back in its original position. This procedure is used to treat nearsightedness between -1.00 and -15.00 diopters with or without astigmatism.

The LASER-K℠ process rarely requires strong pain medication.

Who Is Eligible For LASER-K℠ Surgery?

People thinking about the LASER-K℠ process should:

- be at least 18 years of age or older; and,
- have stable vision for at least one year (If you are under 21 years old, your vision should not have changed by more than 0.5 diopters. If you are 21 years old or older, your vision should not have changed by more than one diopter);
- have between -1.00 diopter and -15.00 diopters of nearsightedness with or without astigmatism up to 5 diopters.

Vision Correction Alternatives

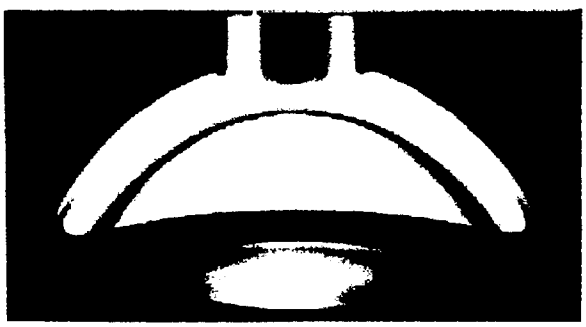
Non-Surgical

- Glasses

- Contact lenses

Surgical

- RK (Radial Keratotomy)
  This was the first surgical procedure available for vision correction. The doctor places spoke-like incisions on the front surface of the cornea to correct mild nearsightedness.



- PRK (Photo Refractive Keratectomy)
  The surface cells are removed and discarded. An excimer laser is used to change the shape of the cornea so light can focus directly on the back of the eye. The surface gradually heals. This procedure usually requires pain medication, and is effective for low and moderate degrees of nearsightedness with or without astigmatism.

- ALK (Automated Lamellar Keratectomy)
  A corneal flap is formed and part of the cornea under the surface is then removed with a blade.

Risks and Benefits of LASER-K^{SM} Surgery

Potential Benefits:

1. LASER-K^{SM} can reduce nearsightedness and reduce or eliminate your need for glasses or contact lenses.
2. LASER-K^{SM} can be an alternative to glasses for patients who cannot wear contact lenses.

Potential Risks:

1. Temporary Changes in Vision
   Temporary changes in vision are normal right after the surgery. These changes can occur in one or both eyes and may vary from patient to patient. Visual recovery for routine activities usually occurs within a few days. Your vision will become stable within 3 to 6 months

2. May Require Repeat Procedures
   Your LASER-K^{SM} procedure may not fully correct your vision. About four percent (4 %) of our patients require a second procedure to reach the desired amount of correction. For those patients requiring a repeat procedure, the risks are increased and the results are not as good.

3. May Develop Irregular Astigmatism
   The surface of your cornea may become less smooth after surgery, which can produce irregular astigmatism. Some patients have experienced this problem, which can result in more glare, halos around lights and in some cases decreased vision. Irregular astigmatism is usually treated by glasses, contact lenses. However, these symptoms may persist regardless of method of treatment.

4. Decreased Vision at Night
You may have more difficulty seeing in conditions such as very dim light, rain, snow, fog or glare from bright lights at night. During the final study, about 1.1 percent (7 out of 661) of our patients have experienced this problem 6 months after the procedure.

5. May See Starbursts, Halos and/or Glare at Night
At night, your pupils may become larger than the treatment zone. This can lead to starbursts (noticeable streaks in lights), halos and/or glare at night. In our final study, about 0.8 percent (5 out of 661) of our patients experienced this problem and another 1.1% experienced halos up to 6 months after surgery. We may give you eye drops that make your pupils smaller at night. You can drive while using the eye drops. The effects of the eye drops last a few hours.

6. May Require a Pair of Glasses for Driving, Movies, Etc.
Some patients may need to wear a pair of glasses or contact lenses after the procedure.

7. May Require Reading Glasses for Near Vision
During the first 1-2 weeks after your surgery, your near vision may be blurred and you may temporarily require the use of reading glasses. This effect should go away with time. However, most people require reading glasses after the age of 40 to 45, whether or not they have this procedure.

8. Possible Risk of Decreased Vision or Loss of Vision
As with any surgery, there is a risk of infection after the surgery. This can lead to scarring, decreased vision, or loss of vision.

9. If your refraction is greater than 7 diopters, the accuracy is less and the possibility of complications is more than if your refraction is less than 7 diopters.

Contraindications To LASER-K^{SM}

You should not have LASER-K^{SM} surgery if you:

- have an active ocular / systemic infection;
- are pregnant or nursing;
- have keratoconus (thinning, cone-like cornea);
- have scars on your eye affecting vision;
- have Fuch's corneal dystrophy;
- have a cornea which is too thin to achieve the desired correction.

Warnings

You should discuss in detail with your surgeon if you:

- have an eye infection;

- have a history of Herpes simplex virus or Herpes zoster (clusters of small blisters on skin or eyes);

- have a collagen vascular disorder (e.g. Rheumatoid arthritis, Systemic lupus erythematosis, etc.);

- Situations where the remaining corneal thickness is insufficient (less than 250 microns) may result in the loss of 2 or more lines of visual acuity that can be corrected by spectacles.

Precautions

The safety and effectiveness of the LASER-K℠ procedure has not been established in patients who have:

- Severe dry eye syndrome (lack of a lot of tears);
- Glaucoma (disease of pressure in the eye);
- Uveitis (iris tissue is inflamed);
- Blepharitis (eyelid/eye lash area is inflamed);
- Psoriasis (skin disease-dry, flaky skin);
- Immunosuppression (immune system weakened);
- Systemic or topical use of steroids.
- Keloid formations
- If you have myopia between 13 and 15 diopters and /or astigmatism between 4 and 5 diopters, please note that the reported safety and effectiveness for these refractive ranges is less reliable due to the smaller numbers of eyes studied.
- For patients with myopia above 7 diopters, there is a 9% chance that your vision may be less than 20/25 if it was 20/20 or better previously
- There is no data for safety and effectiveness for this laser for surface ablation.

What You Need To Know Before And After LASER-K^{SM}

What To Expect Before Surgery

If you are thinking about having LASER-K^{SM} surgery, first discuss it with your doctor. Many times we are able to work with your doctor in order to decrease the number of visits to the surgery center.

You will first have pre-operative testing for surgery. This testing will include a complete medical history of the eye, a vision check and a mapping of the cornea and eye muscle movements. We will dilate your eyes, so you may prefer to have someone drive you to this visit. Other tests include checking for eye dominance, tear function and brightness acuity testing.

During your pre-operative testing, you will discuss your case with the doctor who will perform your surgery. The doctor will also review the risks and benefits of the surgery. If you decide to have surgery, we will schedule a date for you.

We will give you instructions to follow before having the surgery. We will also go over these with you at your pre-operative testing.

Please arrange for a friend or family member to bring you to and from the surgery center on the day of your procedure and your one day follow up visit.

What To Expect The Day Of Surgery

When you arrive at the surgery center, you will check in. You will be taken to the pre-operative area. Here numbing eye drops are placed in your eye(s). You will be taken into the surgery suite on a wheelchair. You will be helped onto the patient chair. The nurses will help you to lay face up on the chair. You will receive more eye drops.

The surgery takes about 10 minutes per eye. Your eye(s) will be held open by an instrument called a lid speculum. You will be asked to look straight ahead at a light on the microscope. The doctor will place a suction ring on the eye to stabilize and raise the intraocular pressure. Then he will attach an instrument called a microkeratome to the suction ring which will create the flap. The excimer laser then removes very thin layers of the underlying cells without damaging the nearby layers. After the laser, the doctor will replace the surface cells to their original position.

After the surgery, your eye(s) will be covered with a clear eye shield for safety. Be careful after your surgery, and DO NOT rub your eye(s).

Please do not drive until your doctor gives you permission.

What To Expect After Surgery

The eye shield(s) is removed at your one day follow up visit. However, you will wear them at bedtime for the first week after your surgery for safety.

We will give you prescriptions for eye drops to use after your surgery. One prescription is for an antibiotic which will help prevent infection. The second will control inflammation. If needed, you will also have a prescription for pain.

You are to use the eye drops for four days. After you finish these drops you can use artificial tears to help moisten your eyes, if needed.

Your vision after surgery will be changing over the next few weeks. Usually by 4 to 6 weeks after surgery, your vision will be stable. Generally, however, you can expect to return to normal daily activities within 1 to 2 days of your surgery. Some patients take longer, so we ask that you keep your schedule flexible.

During your healing time you may see glare around lights and/or starbursting at night (a streaking of lights). These side effects will decrease over time and usually stop.

Your post-operative visits are at: 1 day, 1 week, 1 month, 3 months, 6 months and 12 months.

Again, please do not drive until your doctor gives you permission.

Questions To Ask Your Doctor

1. **Is the LASER-K℠ process painful?** For most people there is little or no pain associated with the LASER-K℠ process. Many report it feels scratchy and teary for about two hours after the process. In general, strong pain medication is not required.

2. **When can I return to work following the procedure?** Typically, you can return to work within 1 to 2 days. More time may be required, so we ask you to keep your schedule flexible.

3. **How long is the healing process?** Your visual recovery for routine activities usually occurs within a few days. Your vision will completely stabilize within 3 to 6 months.

4. **How will my post-operative care be handled if I come from out of town?** We see patients from all over the U.S. and other countries. We often work with your local doctor. The first post-operative visit will be performed at our center. Your local doctor will perform the rest of your post-operative visits. Information from these visits will be recorded and sent to our center.

5. **Who will perform the LASER-K℠ process?** Dr. Frederic B. Kremer, Dr. George R. Pronesti and Dr. Michael Aronsky are the doctors who perform the LASER-K℠ process at the Kremer Laser Eye Center.

6. **Are eye drops required after the LASER-K℠ process?** The LASER-K℠ process typically requires antibiotic and anti-inflammatory eye drops for four days.

7. **What about eye shields or bandage lenses?** After the LASER-K℠ process, we provide eye shield(s) for use at bedtime for the first week for safety. No bandage contact lenses are required.

8. **Will I need glasses after the process?** You should be able to do all or most things without glasses. Some patients may require glasses for some activities like driving at night. In some cases, glasses or contact lenses may still be required. Most people who are older than 40-45 will need reading glasses for near work regardless of whether these procedures are done. Talk to your doctor.