P010018

SUMMARY OF SAFETY AND EFFECTIVENESS DATA

ViewPoint™ CK System

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I. GENERAL INFORMATION

Device Generic Name:	RF Electrosurgical Device
Device Trade Name:	ViewPoint™ CK System
Applicant's Name and Address:	Refractec, Inc. 5 Jenner, Suite 150 Irvine, California 92618 U.S. (949) 784-2600 (949) 784-2601 (fax)
Date of Panel Recommendation:	11/30/2001
PMA Number:	P010018
Date of GMP Inspection:	July 25, 2001
Date of Notice of Approval to Applicant:	April 11, 2002

II. INDICATIONS FOR USE

The ViewPoint™ CK System / Conductive Keratoplasty^{SM} (CK^{SM}) Procedure is indicated for the temporary reduction of spherical hyperopia in patients who have 0.75 D to 3.25 D of cycloplegic spherical hyperopia, less than or equal to 0.75 D of refractive astigmatism (minus cylinder format), a cycloplegic spherical equivalent of 0.75 D to 3.00 D, and are 40 years of age or greater with a documented stability of refraction for the prior 12 months, as demonstrated by a change of less than 0.50 D in spherical and cylindrical components of the manifest refraction. The magnitude of correction with this treatment diminishes over time, with some patients retaining some or all of their intended refractive correction.

III. CONTRAINDICATIONS

Conductive Keratoplasty^{SM} treatment with the ViewPoint™ CK System is contraindicated in:

- Patients with a peripheral pachymetry reading, measured at the 6 mm optical zone, of less than 560 microns.
- Patients who have had previous strabismus surgery or are likely to develop strabismus following the CK^{SM} procedure.
- Patients with a history of Herpes zoster or Herpes simplex keratitis.
- Patients who have diabetes, diagnosed autoimmune disease, connective tissue disease, or clinically significant atopic syndrome.

- Patients who are being treated with chronic systemic corticosteroid or other immunosuppressive therapy that may affect wound healing, and any immunocompromised patients.
- Patients who are pregnant or lactating.
- Patients with keratoconus.
- Patients with a history of keloid formation.
- Patients with intractable keratoconjunctivitis sicca.
- Patients with implantable electrical devices (pacemakers, defibrillators, cochlear implants, etc.).
- Patients with narrow angles.

IV. WARNINGS AND PRECAUTIONS

The warnings and precautions can be found in the device labeling.

V. DEVICE DESCRIPTION

The ViewPoint™ CK System is designed to treat spherical, previously untreated hyperopia of 0.75 to 3.25 D through a procedure known as Conductive Keratoplasty℠ (CK℠).

Conductive Keratoplasty℠ utilizes low energy, delivered directly into the corneal stroma through a handpiece and Keratoplast™ Tip, to effect refractive change in the cornea. As a result of conducting a controlled amount of radiofrequency energy into the corneal stroma, the desired collagen shrinkage temperature is achieved. The peripheral application of this treatment in a predetermined pattern creates a band of tightening and results in a steepening of the central cornea. This steepening results in the desired refractive effect.

Overview of the ViewPoint™ CK System

The ViewPoint™ CK System used to perform the CK℠ procedure consists of the following components:

- Radiofrequency energy-generating console
- Reusable corneal marker
- Reusable lid speculum with cable and connector
- Reusable hand-held, pen-shaped handpiece with cable and connector
- Footpedal
- Disposable Keratoplast™ Tip
- Patient treatment card

Refractec submitted declarations that the ViewPoint™ CK System conforms to the following standards:

- ISO/EN 60601-1 Electrical Safety
- ISO/EN 60601-1-2 EMC

- ISO/EN 60601-2-2 Electrical Safety For RF
- ISO/EN 60601-1-4 Programmable Electrical Medical Systems
- ISO 10993 Biocompatibility
- ISO 10993-7 ETO Residuals
- ISO 11135 ETO Sterilization

ViewPoint™ CK System Console

A patient treatment card is inserted into the console to activate the system. The energy level is set at 60% power (0.6W) with a treatment time of 0.6 seconds. Selection of parameters outside the default settings is not allowed in the U.S. market version. An AC powered, portable, low power, energy source provides regulated radiofrequency energy through the handpiece to the Keratoplast™ Tip.

Handpiece

The handpiece is a hand-held, reusable, pen-shaped instrument attached by a removable cable and connector to the console. The radiofrequency energy is delivered by means of the Keratoplast™ Tip, which attaches to the handpiece.

Keratoplast™ Tip

A sterile, disposable, stainless steel, Keratoplast™ Tip, 90 µm in diameter and 450 µm long, that delivers radiofrequency energy directly to the corneal stroma, is attached to the handpiece. The Keratoplast™ Tip has a proximal bend of 45° and a distal bend of 90° to allow access to the cornea over the patient's brow and nasal regions. A Teflon® stop at the very distal portion of the stainless steel tip assures correct depth of penetration. The Keratoplast™ Tip must not be used on fellow eyes or subsequent patients.

Lid Speculum

The lid speculum serves as the return (dispersive) electrode for the radiofrequency energy being delivered through the Keratoplast™ Tip. Two types of specula are offered: Barraquer type and Lancaster type. The Barraquer type is a small, malleable wire-speculum and the Lancaster is a locking speculum. The Lancaster lid speculum was not used in the clinical investigation of the device, but is considered equivalent for the purpose of a return electrode.

Footpedal

The footpedal attaches to the console and controls the release of radiofrequency energy.

Patient Treatment Card
A patient treatment card is inserted into the console to activate the system.

Safety Features
The ViewPoint™ CK System has numerous features to assure proper operation. The ViewPoint™ CK System includes safety checks at start-up and monitors output during treatment.

Software
The ViewPoint™ CK System software controls the user interface, and provides the user with system diagnostics and error messages in the event of a device anomaly. Additionally, the software saves all error messages to the patient treatment card to assist in the diagnosis of technical issues.

VI. ALTERNATIVE PRACTICES OR PROCEDURES

Alternative methods of correcting farsightedness (hyperopia) include: spectacles, contact lenses, laser *in situ* keratomileusis (LASIK), photorefractive keratectomy (PRK), and laser thermal keratoplasty (LTK).

VII. MARKETING HISTORY

The ViewPoint™ CK System has not been marketed in the United States. The ViewPoint™ CK System was first marketed outside the United States in March 2001. Refractec, Inc. has 27 ViewPoint™ CK Systems located in 15 countries (Australia, Brazil, Argentina, Mexico, Canada, United Kingdom, France, Finland, Spain, Italy, Germany, Greece, Saudi Arabia, South Africa, and Paraguay). The ViewPoint™ CK System has not been withdrawn from any country or market for reasons of safety and effectiveness.

VIII. POTENTIAL ADVERSE EFFECTS OF THE DEVICE ON HEALTH

Potential adverse events associated with the CK^{SM} procedure include: decrease in BSCVA of > 10 letters not due to irregular astigmatism as shown by hard contact lens refraction at 6 months or later, IOP > 25 mm Hg, secondary surgical intervention other than CK treatment, late onset of haze beyond 6 months with loss of 2 lines (10 letters) or more BSCVA, a corneal epithelial defect involving the treatment site, corneal edema, corneal microbial infection, corneal decompensation, corneal scar in the visual axis, intraocular infection, hypopyon, hyphema, onset of cataract unrelated to age/systemic disease/ trauma, retinal detachment, retinal vascular accidents.

Please refer to the complete listings of adverse events and complications observed during the clinical study, which are presented on pages 22 and 23 in the Summary of Clinical Studies section.

IX. SUMMARY OF PRECLINICAL STUDIES

A. Objectives

Preclinical studies were conducted to establish the safety and performance of the ViewPoint™ CK System.

B. Design Verification

Upon completion of the assembly and testing of prototype units, the output of the device was evaluated to assess the waveform and to verify that the output met the original design intent. This report concluded that the waveform generated by the prototype device meets the design intent.

C. Electrical Safety Tests

The device has been designed to comply with electrical standards that are recognized domestically and internationally. EN 60601-1 and EN 60601-2-2 Test Reports completed by Intertek Testing Service concluded that the device meets all of the applicable elements of these standards.

D. EMC Compliance

The device has been designed and tested to assure that the unit meets the applicable elements on EN 60601-1-2. The test report completed by Intertek Testing Service concluded that the device meets this standard for EMC compliance.

E. Physical Tests

1. Treatment probe dimensional/physical properties testing:
   Qualification of the manufacturing and assembly process was conducted to verify that dimensional specifications were met and that process variability was within acceptable limits. Testing included dimensional analysis, visual inspection of the tip after repeated insertions and activation of radiofrequency energy, and evaluation of the glue bond between the Teflon® stop and the tip. The test report shows that the tip dimensions fall within an acceptable tolerance range, the glue bond is sufficient to withstand forces encountered during the procedure, and that repeated insertion and conductance of radiofrequency energy does not adversely affect the tip.

2. Return Electrode Heat Transfer Study:
   A study was conducted to confirm that there are no adverse heating effects at the return electrode (the lid speculum). This study confirmed that the radiofrequency energy applied to the treatment probe caused localized heating at the treatment site and that there was no evidence of heating at the return electrode.

F. Physical Safety Tests

Sterility Validation and Expiration Dating: The device is terminally sterilized in its package utilizing a 100% ETO cycle that has been validated. The sterilization cycle provides a 10^{-6} Sterility Assurance Level (SAL). Accelerated and Real Time aging studies confirm the labeled expiration date.

G. Biocompatibility

The contact material of the tip is a medical grade 420 series Stainless Steel. This material is of known biocompatibility.

H. Performance Testing

Each device is evaluated against a Final Test Procedure as part of the manufacturing/assembly process. This Test Procedure includes calibration and verification of the critical waveform parameters as well as other performance criteria. The Test Procedure has been completed as part of the manufacturing process validation on five prototype units. The results of these tests are on file with the contract manufacturer and as part of the Design History File at Refractec. The results of the validation were found to be acceptable.

I. Electrical and Thermal Simulation

Computer simulation of the ViewPoint™ CK System was performed in order to analyze the power deposition pattern and thermal profile surrounding the needle tip. This simulation consisted of two steps. First, the needle tip was assigned a voltage with respect to the return electrode; other boundary conditions were defined on the surface of a rectangular volume as required. This information was analyzed by using a computer program to solve the Laplace equation to calculate the potential distribution within the volume. The electric field, power density, and circuit impedance were then calculated. Once power density was identified, this value was used as the heating source input into a program that solved a bioheat equation, calculating the temperature distribution within the volume as a function of time. The applied power was then modified to simulate the effect of tissue coagulation or desiccation that occurs over time.

Temperature distributions were computed throughout the entire simulation volume. Based on the power deposition patterns computed from the electric field modeling program, the highest temperatures were predicted to be achieved along the axis of the needle and near the needle tip. At a distance from the needle, where power deposition was insignificant, increase in temperature was due to thermal conduction effects. While initially, maximum heating occurred near the needle tip, with increasing temperature, heating extended along the needle shaft, and ultimately spread at later points to tissue elements located further away from the tip. The extent of the thermal lesion produced was shown to be a function of both time and temperature.

J. Histopathology

As part of the clinical evaluation of the ViewPoint™ CK System, six subjects scheduled for penetrating keratoplasty underwent the CK℠ procedure 24 to 48 hours prior to penetrating keratoplasty (PK). Histology was performed on the corneal tissue obtained from these subjects.

Initially, the corneal tissue was examined to determine the exact location of the radiofrequency applications, and to ensure that the section selected for histopathologic processing did not have any evidence of the underlying pathology that necessitated penetrating keratoplasty. The selected specimen was then processed and stained, and evaluated under high-powered light microscopy.

Histopathologic examination revealed a V-shaped or U-shaped stromal thermal footprint at the site of the radiofrequency application that clearly demarcated the shrunken collagen from the surrounding preserved lamellae. A bullous-like separation of epithelium from the underlying Bowman's layer, or a total absence of epithelium at the site of the CK^{SM} application was observed. Epithelial cells at the site of the CK^{SM} application were abnormal, with necrotic, shrunken nuclei. Bowman's layer remained intact in all of the sections examined. The keratocyte population was decreased or shrunken, with edema between the stromal lamellae, and collagen disorganization. The surrounding stroma maintained its normal staining properties, with preservation of collagen structure and keratocyte nuclei. No inflammatory cells were observed within the area of the CK^{SM} application. Descemet's membrane was continuous, with no folds.

Based on this histological study of human corneas, it can be concluded that Conductive Keratoplasty^{SM} was not associated with an inflammatory response, and no damage to either Bowman's layer or Descemet's membrane in the areas of application was observed.

K. Conclusions

The preclinical testing provided evidence to support the conclusion that the device did not present an unreasonable risk to subjects and could proceed to clinical trials under an approved investigational device exemption (IDE).

X. SUMMARY OF CLINICAL STUDIES

Refractec, Inc. conducted a clinical study of the ViewPoint™ CK System in the U.S. under IDE #G980224. The data from this study served as the basis for the approval decision. Safety and effectiveness outcomes through 12 months post-treatment were evaluated for confirmation.

A. Objectives

The objective of the clinical study was to evaluate the safety and effectiveness of the ViewPoint™ CK System in the correction of low to moderate spherical hyperopia.

B. Study Design

This study was a prospective, multi-center clinical study where the primary control was the preoperative status of the treated eye.

1. Inclusion and Exclusion Criteria

Enrollment in the Refractec clinical study was limited to patients who:

- Had 0.75 to 3.25 D of manifest spherical hyperopia, ≤ 0.75 D of refractive astigmatism, and 0.75 to 3.00 D of spherical equivalent by cycloplegic refraction in the eye to be treated.
- Had spherical equivalent manifest refraction and spherical equivalent cycloplegic refraction that did not differ by more than 0.50 D.
- Discontinued using hard or rigid gas permeable contact lenses for at least 3 weeks and discontinued using soft contact lenses for at least 2 weeks prior to the preoperative evaluation in the eye to be treated.
- For hard contact lens wearers – had 2 central keratometry readings and 2 manifest refractions taken at least one week apart, the last of which did not differ from the previous values by more than 0.50 D in either meridian; mires were regular in the eye to be treated.
- Had visual acuity correctable to at least 20/40 in both eyes.
- Were at least 21 years of age.
- Were willing and able to return for scheduled follow-up examinations for 24 months after surgery.
- Provided written informed consent.
- Were able to tolerate their full cycloplegic correction while not under cycloplegia.

Patients with the following conditions were excluded from the study:

- Previous strabismus surgery, or who would have been likely to develop strabismus following the CK℠ procedure.
- Anterior segment pathology, including cataracts (in the operative eye).
- Any corneal abnormality (in the operative eye).
- Progressive or unstable hyperopia (in the operative eye).
- Latent hyperopia.
- Distorted or unclear corneal mires.
- Blind in the fellow eye.
- Previous intraocular or corneal surgery.
- History of Herpes zoster or Herpes simplex keratitis.
- History of steroid-responsive rise in IOP, glaucoma, or preoperative IOP > 21 mm Hg.
- At risk for angle closure or with a potentially occludable angle.
- Diabetes, diagnosed autoimmune disease, connective tissue disease, or clinically significant atopic syndrome.

- Chronic systemic corticosteroid or other immunosuppressive therapy, and any immunocompromised patients.
- Using ophthalmic medication(s) other than artificial tears for treatment of any ocular pathology.
- Using systemic medications with significant ocular side effects.
- History of keloid formation.
- Intractable keratoconjunctivitis sicca.
- Pregnant, planning to be pregnant, or lactating during the course of the study.
- Known sensitivity to planned study concomitant medications.
- Participating in any other ophthalmic drug or device clinical trial during the time of this clinical investigation.
- Peripheral pachymetry reading of less than 560 microns.
- Distance UCVA better than 20/32.

2. Study Endpoints

The following primary study parameters were evaluated in the determination of safety and effectiveness of the Refractec ViewPoint™ CK System.

Primary Safety Parameter:

- Preservation of best corrected visual acuity: less than 5% of eyes should lose more than two lines of best corrected visual acuity at the postoperative interval at which stability has been established.

Primary Effectiveness Parameter:

- Predictability: 75% of eyes should have a manifest refraction spherical equivalent within $\pm$1.00 D of the attempted correction at the postoperative interval at which stability has been established.

The following secondary study parameters were evaluated in the determination of safety and effectiveness of the Refractec ViewPoint™ CK System.

Secondary Safety Parameters:

- Preservation of best corrected visual acuity: less than 1% of eyes with preoperative BSCVA of 20/20 should have a visual acuity outcome worse than 20/40 BSCVA at the postoperative interval at which stability has been established.
- Mean extent of induced manifest refractive astigmatism: less than 5% of eyes should have a postoperative manifest refractive astigmatism

that varies from target amount by greater than 2.00 D at the postoperative interval at which stability has been established.

- Results of slit lamp examination: less than 1% of eyes should have clinically significant haze, defined as a decrease in BSCVA of >2 lines not due to irregular astigmatism, at the postoperative interval at which stability has been established.
- Central endothelial cell loss: mean endothelial cell loss should be no more than 10% at the postoperative interval at which stability has been established.
- Cumulative incidence of adverse events. Adverse events should occur in less than 5% of eyes and any single adverse event should occur in less than 1% of eyes.

Secondary Effectiveness Parameters:

- Predictability: 50% of eyes should have a manifest refraction spherical equivalent within ± 0.50 D of attempted correction at the postoperative interval at which stability has been established.
- Stability (absence of change in refractive outcome over time): 95% of eyes should have a change of ≤ 1.00 D in manifest refraction spherical equivalent between two refractions performed at least three months apart.
- Improvement in uncorrected visual acuity: 85% of eyes who had 20/20 or better spectacle-corrected visual acuity preoperatively, and for whom the intended target correction was emmetropia should have an uncorrected visual acuity of 20/40 or better at the postoperative interval at which stability has been established. For those eyes which had spectacle-corrected visual acuity of worse than 20/20 but at least 20/40 preoperatively, and for which the intended target correction was emmetropia, 75% should have an uncorrected visual acuity of 20/40 or better at the postoperative interval at which stability has been established.
- Decrease in manifest refraction spherical equivalent and astigmatism: 75% of eyes should be within ± 1.00 D of attempted spherical and astigmatism correction at the postoperative interval at which stability has been established.
- Subject satisfaction as measured by subjective questionnaire.

C. Study Plan and Subject Assessments

1. Study Plan

All subjects were expected to return for follow-up examinations at one day, one week, and 1, 3, 6, 9, 12, and 24 months post-treatment. After the first 50 eyes were evaluated, the option to perform simultaneous bilateral surgery was left to the discretion of the investigator. Retreatments were not attempted in this study.

2. Subject Assessments and Efficacy Criteria

- Distance visual acuity, uncorrected and best spectacle-corrected, using ETDRS charts
- Manifest refraction (no auto-refraction)
- Cycloplegic refraction
- Pachymetry
- Intraocular pressure (applanation)
- Slit lamp examination
- Fundus examination (dilated)
- Specular microscopy of the central and peripheral corneal endothelium (in a subgroup of 100 subjects)
- Mesopic contrast sensitivity, with and without glare (subgroup)
- Computerized corneal topography (postoperatively in eyes with anomalous refractive outcomes)
- Central keratometry
- Subject self-evaluation/questionnaire

D. Study Period and Investigational Sites

Subjects were treated between 2/10/1999 and 12/01/2000 at 12 investigational sites. The database for this PMA cohort reflected data collected through 10/01/2001 and included 401 eyes: 233 primary eyes and 168 fellow eyes.

E. Demographic Data

Of the 233 subjects, 58% were female and 42% were male. The mean age for all enrolled subjects was 55.3 years, with a range from 40 to 73 years. The study population consisted primarily of Caucasians (81%). Mean hyperopia (CRSE) prior to surgery was 1.86 diopters.

Table 1
Demographics
All Eyes Enrolled

401 Eyes of 233 Enrolled Subjects

Gender	Male	42%
	Female	58%
Race	Caucasian	81%
	Black	9%
	Asian	2%
	Other	9%
Eye	Left	49%
	Right	51%
Age (yrs)	N	233
	Mean	55.3
	95% Confidence Interval	54.5,56.1
	Standard Deviation	6.36
	Median	55.6
	Range	40.2,73.9
Range of Treatment - CRSE	N	401
	Mean	1.86
	95% Confidence Interval	1.80,1.92
	Standard Deviation	0.628
	Median	1.75
	Range	0.75,4.00
Range of Treatment - MRSE	N	401
	Mean	1.80
	95% Confidence Interval	1.74,1.86
	Standard Deviation	0.637
	Median	1.75
	Range*	-0.38,3.75

F. Data Analysis and Results

The protocol was amended after enrollment of the initial cohort of 54 eyes to reflect a decrease in the maximum spherical hyperopia to be corrected by CK^{SM}. A modified nomogram that shifted the treatment ranges and number of spots also reduced the maximum CK^{SM} treatment from 4.00 D to 3.25 D spherical hyperopia (CRSE 3.00 D). Thus the nomogram identified as "current nomogram" specifies a treatment range of 0.75 D to 3.25 D spherical hyperopia, a spherical equivalent of 0.75 D to 3.00 D, and no more than 0.75 D absolute cylinder.

Of the 54 eyes that underwent CK^{SM} during the first phase of study, only 25 eyes fit into the modified CK^{SM} nomogram. The remaining 29 eyes fell outside of the treatment ranges defined in the modified nomogram, identified throughout this report as the "current nomogram," which was used for the remainder of the study. Since these 29 eyes were not treated with the current nomogram, their refractive outcomes do not reflect the effectiveness of the current nomogram, and on this basis, they have been excluded from the effectiveness outcomes, i.e., uncorrected visual acuity, accuracy of intended (target) to achieved refraction, expressed as spherical equivalent manifest refraction or MRSE, and mean postoperative refraction, also expressed as MRSE. An additional 9 eyes were treated outside the current nomogram as a result of protocol deviations or surgeon error, and have also been excluded from analyses of effectiveness. All eyes have been included in analyses of the stability and safety parameters.

1. Pre-Treatment Characteristics

Table 2 presents a summary of the pre-treatment visual acuity and refraction. The treatment goal for all eyes was emmetropia.

Table 2
Preoperative Refractive Parameters
Eyes Treated with Current Nomogram

		Primary Eyes		Fellow Eyes		All Eyes	
Spherical Equivalent (MRSE) *	0.0-0.99 D	11	6%	11	7%	22	6%
	1.0-1.99 D	121	61%	84	52%	205	57%
	2.0-2.99 D	62	31%	63	39%	125	35%
	3.0-4.00 D	5	3%	4	2%	9	2%
	Total	199	100%	162	100%	361	100%
Cylinder (manifest) **	0.00 D	69	35%	57	35%	126	35%
	0.25 D	41	21%	38	23%	79	22%
	0.50 D	59	30%	49	30%	108	30%
	0.75 D	28	14%	18	11%	46	13%
	1.00 D	3	2%	1	1%	4	1%
	1.25 D	0	0%	0	0%	0	0%
	Total	200	100%	163	100%	363	100%
Spherical Equivalent (CRSE) **	0.0-0.99 D	8	4%	9	6%	17	5%
	1.0-1.99 D	117	59%	85	52%	202	56%
	2.0-2.99 D	65	33%	60	37%	125	34%
	3.0-4.00 D	10	5%	9	6%	19	5%
	Total	200	100%	163	100%	363	100%
Cylinder (cycloplegic) **	0.00 D	69	35%	67	41%	136	37%
	0.25 D	29	15%	36	22%	65	18%
	0.50 D	75	38%	39	24%	114	31%
	0.75 D	26	13%	21	13%	47	13%
	1.00 D	1	1%	0	0%	1	<1%
	1.25 D	0	0%	0	0%	0	0%
	Total	200	100%	163	100%	363	100%

* Excludes two ineligible eyes with minus MRSE; these eyes are included in the cylinder analysis.
** Includes one ineligible eye with >0.75 D cycloplegic cylinder.

2. Subject Accountability

Of the 401 eyes enrolled in the study, follow-up data through 12 months postoperative are available for 344 eyes (95%). Of the remaining eyes, one (<1%) was discontinued from the study, 4 eyes (1%) were lost to follow-up, and 14 eyes (4%) were not yet eligible for the visit.

Table 3
Accountability
Eyes Treated with Current Nomogram

	Month 1		Month 3		Month 6		Month 9		Month 12	
Available for Analysis	354/363	98%	358/363	99%	352/363	97%	350/363	96%	344/363	95%
Discontinued	1/363	<1%	1/363	<1%	1/363	<1%	1/363	<1%	1/363	<1%
Missed Visit	8/363	2%	4/363	1%	10/363	3%	10/363	3%	0/363	0%
Not yet eligible for interval	0/363	0%	0/363	0%	0/363	0%	0/363	0%	14/363	4%
Lost to Follow-up	0/363	0%	0/363	0%	0/363	0%	2/363	1%	4/363	1%
Accountability	354/363	98%	358/363	99%	352/363	97%	350/363	96%	344/349	99%

3. Summary of Key Effectiveness Variables

Table 4 demonstrates that the key effectiveness outcomes at 6 months postoperative meet or exceed the outcomes recommended in the October 10, 1996 *FDA Guidance for Refractive Surgery Lasers*.

Table 4
Summary of Key Efficacy Variables
Eyes Treated with Current Nomogram

	Month 1	Month 3*	Month 6	Month 9	Month 12
Efficacy Variables					
UCVA 20/20 or better	29%	40%	45%	49%	56%
UCVA 20/25 or better	51%	63%	64%	73%	75%
UCVA 20/40 or better	79%	86%	90%	93%	92%
MRSE ≤ 0.50 D	47%	56%	61%	63%	62%
MRSE ≤ 1.00 D	75%	83%	88%	87%	89%
MRSE ≤ 2.00 D	94%	97%	99%	99%	99%

* Two eyes were excluded from the 3 Month MRSE efficacy variables due to manifest refraction and BSCVA not performed.

Table 5
Summary of Key Efficacy Variables at 12 Months
Preoperative MRSE Stratified by Dioptric Group
Eyes Treated with Current Nomogram

	0.00 to 0.99 D	1.00 to 1.99 D	2.00 to 3.25 D
Efficacy Variables			
UCVA 20/20 or better	64%	59%	48%
UCVA 20/25 or better	73%	77%	72%
UCVA 20/40 or better	91%	94%	90%
MRSE ≤ 0.50 D	82%	68%	50%
MRSE ≤ 1.00 D	100%	94%	78%
MRSE ≤ 2.00 D	100%	100%	98%

Table 6
Summary of Key Efficacy Variables at 12 Months
Stratified by Treatment Spots Applied
Eyes Treated with Current Nomogram

	8 Spots*	16 Spots*	24 Spots*	32 Spots*
Efficacy Variables				
UCVA 20/20 or better	67%	63%	49%	49%
UCVA 20/25 or better	80%	77%	73%	71%
UCVA 20/40 or better	93%	96%	92%	87%
MRSE ≤ 0.50 D	100%	70%	60%	41%
MRSE ≤ 1.00 D	100%	96%	92%	67%
MRSE ≤ 2.00 D	100%	100%	100%	97%

* 8 spots = CRSE 0.75 to 0.875 D
16 spots = CRSE 1.00 to 1.625 D
24 spots = CRSE 1.75 to 2.25 D
32 spots = CRSE 2.375 to 3.00 D

4. Change in Manifest Refraction Over Time

Table 7
Stability of Manifest Refraction through 12 Months
Patients with Consecutive visits
All Eyes Treated

	Between 3 and 6 Months	Between 6 and 9 Months	Between 9 and 12 Months
Change in MRSE ≤ 0.50 D	74%	89%	88%
Change in MRSE ≤ 0.75 D	87%	95%	96%
Change in MRSE ≤ 1.00 D	93%	98%	97%
Change in MRSE			
Mean	0.26	0.10	0.14
95% Confidence Interval	0.20,0.32	0.06,0.14	0.10,0.18
Standard Deviation	0.493	0.372	0.362
Change in MRSE per Month			
Mean	0.09	0.03	0.05
95% Confidence Interval	0.07,0.11	0.01,0.05	0.03,0.07
Standard Deviation	0.164	0.124	0.121

Table 8
Mean MRSE by Visit
12 Month Cohort
Eyes Treated with Current Nomogram

	Baseline	1 Month	3 Months	6 Months	9 Months	12 Months
N	325	325	323	325	325	325
Mean	1.77	-0.56	-0.29	-0.04	0.05	0.19
95% Confidence Interval	1.71,1.83	-0.66,-0.46	-0.37,-0.21	-0.12,0.04	-0.03,0.13	0.11,0.27
Standard Deviation	0.587	0.889	0.781	0.727	0.692	0.662

a. Factors Associated with Outcomes

Statistical modeling performed on the data generated in the CK^{SM} clinical study found no effect of age, race, sex or clinical site on outcomes.

b. Subject Satisfaction

Subjects were asked to rate their quality of vision compared to before the Conductive Keratoplasty^{SM} (CK^{SM}) procedure. Table 9 shows the percentage of subjects that rated each condition as improvement that was "extreme," "marked," "moderate," "slight," or "no improvement".

Table 9
Quality of Vision

	Month 1		Month 3		Month 6		Month 9		Month 12	
Extreme Improvement	83/353	24%	87/361	24%	109/370	29%	115/366	31%	112/369	30%
Marked Improvement	149/353	42%	159/361	44%	164/370	44%	144/366	39%	160/369	43%
Moderate Improvement	68/353	19%	78/361	22%	57/370	15%	67/366	18%	61/369	17%
Slight Improvement	37/353	10%	22/361	6%	28/370	8%	28/366	8%	26/369	7%
No Improvement	16/353	5%	15/361	4%	12/370	3%	12/366	3%	10/369	3%

Overall subject satisfaction was assessed on a subject survey at 1, 3, 6, 9, and 12 months post-treatment using a 5-point grading scale from "very satisfied" to "very dissatisfied".

Table 10
Subject Satisfaction

	Month 1		Month 3		Month 6		Month 9		Month 12	
Very Satisfied	161/356	45%	168/362	46%	172/371	46%	181/366	49%	185/369	50%
Satisfied	112/356	31%	118/362	33%	134/371	36%	110/366	30%	115/369	31%
Neutral	57/356	16%	55/362	15%	34/371	9%	42/366	11%	34/369	9%
Dissatisfied	16/356	4%	12/362	3%	20/371	5%	21/366	6%	27/369	7%
Very Dissatisfied	10/356	3%	9/362	2%	11/371	3%	12/366	3%	8/369	2%

Table 11
Need for Distance Correction

	Month 1	Month 3	Month 6	Month 9	Month 12
No	84%	89%	87%	82%	82%
Yes	16%	11%	13%	18%	18%

5. Summary of Key Safety Variables

The following table demonstrates that the key safety outcomes meet or exceed the outcomes recommended in the October 10, 1996 *FDA Guidance for Refractive Surgery Lasers*.

Table 12
Summary of Key Safety Variables
All Eyes Treated

	Month 1	Month 3	Month 6	Month 9	Month 12
Safety Variables*					
Loss of 2 lines BSCVA	6%	5%	4%	3%	2%
Loss of > 2 lines BSCVA	2%	1%	1%	1%	0%
BSCVA worse than 20/40	0%	0%	0%	0%	0%
Increase > 2.00 D cylinder	3%	2%	1%	<1%	<1%
BSCVA worse than 20/25 if 20/20 or better preoperatively	4%	2%	1%	1%	0%

* Two eyes were excluded from all safety variables due to manifest refraction and BSCVA not performed.

Table 13
Summary of Key Safety Variables at 12 Months
Preoperative MRSE Stratified by Dioptric Group
All Eyes Treated

	0.00 to 0.99 D	1.00 to 1.99 D	2.00 to 3.25 D*
Safety Variables			
Loss of 2 lines BSCVA	0%	3%	1%
Loss of > 2 lines BSCVA	0%	0%	0%
BSCVA worse than 20/40	0%	0%	0%
Increase > 2.00 D cylinder	0%	<1%	0%
BSCVA worse than 20/25 if 20/20 or better preoperatively	0%	0%	0%

* Safety variables shown for all treated eyes; includes 2 eyes with preoperative MRSE > 3.25. Neither of these eyes lost ≥ 2 lines BSCVA, had BSCVA worse than 20/40, or increased > 2.00 D cylinder.

Table 14
Summary of Key Safety Variables at 12 Months
Stratified by Treatment Spots Applied
All Eyes Treated

	8 Spots*	16 Spots*	24 Spots*	32 Spots*
Safety Variables				
Loss of 2 lines BSCVA	0%	3%	3%	0%
Loss of > 2 lines BSCVA	0%	0%	0%	0%
BSCVA worse than 20/40	0%	0%	0%	0%
Increase > 2.00 D cylinder	0%	1%	0%	0%
BSCVA worse than 20/25 if 20/20 or better preoperatively	0%	0%	0%	0%

* 8 spots = CRSE 0.75 to 0.875 D
16 spots = CRSE 1.00 to 1.625 D
24 spots = CRSE 1.75 to 2.25 D
32 spots = CRSE 2.375 to 3.00 D

The following adverse events were reported in clinical study of the ViewPoint™ CK System.

Table 15
Adverse Event Summary

	Month 1	Month 3	Month 6	Month 9	Month 12
Decrease in BSCVA of > 10 letters not due to irregular astigmatism as shown by hard contact lens refraction at 6 months or later	0%	0%	0%	0%	<1%
IOP >25 mm Hg	0%	0%	1%	<1%	<1%
Secondary Surgical Intervention other than CK treatment	0%	0%	0%	0%	<1%
Other	1%	1%	<1%	1%	1%

In clinical studies of the ViewPoint™ CK System, the following complication was reported on the day of surgery with a reported rate of <1%:

- Corneal scratch

The following adverse events were reported on the day of surgery at a rate of <1%:

- Corneal perforation
- Procedure could not be performed and had to be rescheduled due to technical difficulties with the CK^{SM} device

Each of the following complications was reported at the one week visit at a rate of less than 1%:

- Blurred vision
- Conjunctivitis
- Double vision
- Stye

The following adverse reaction was reported at one week at a rate of less than 1%:

- Mild iritis

During the first week following surgery patients may experience: pain, discomfort, a feeling of something in the eye lasting from one up to three days after surgery, mild light sensitivity, and swelling of the cornea.

Table 16 presents a summary of the complications reported in the clinical study.

Table 16
Complication Summary
All Eyes Treated

	Month 1	**Month 3**	**Month 6**	**Month 9**	**Month 12**
Recurrent corneal erosion at one month or later	0%	1%	0%	0%	0%
Double/ghost images in the operative eye	1%	1%	2%	1%	1%
Foreign body sensation at one month or later	0%	0%	0%	<1%	0%
Pain at one month or later	0%	1%	0%	0%	0%
Other	2%	3%	2%	1%	1%

The following complications were not reported in the clinical study, but could potentially occur following CK^{SM} procedure: peripheral corneal epithelial defect; corneal edema.

Table 17 below shows the absolute change in refractive cylinder for all eyes treated.

Table 17
Absolute Change in Refractive Cylinder
All Eyes Treated

Astigmatism	Month 1	Month 3	Month 6	Month 9	Month 12
Increase > 2.00 D	3%	2%	1%	<1%	<1%
Increase > 1.00 D	21%	15%	14%	7%	6%

Table 18 presents a comparison of eyes with > 1.00 D induced cylinder and eyes with 1.00 D induced cylinder.

Table 18
Comparison of Eyes with > 1.00 D Induced Cylinder
and Eyes with ≤ 1.00 D Induced Cylinder
All Eyes Treated

	≤ 1.00 D Induced Cylinder		> 1.00 D Induced Cylinder	
	Month 9	Month 12	Month 9	Month 12
Loss of ≥ 2 lines BSCVA	4%	3%	4%	0%
No Change (± 1 line)	93%	94%	96%	96%
Increase of ≥ 2 lines BSCVA	3%	4%	0%	5%
UCVA 20/20 or better	52%	57%	9%	35%
UCVA 20/25 or better	75%	76%	43%	47%
UCVA 20/40 or better	93%	94%	83%	71%
UCVA				
N	327	327	23	17
Mean	26.22	25.75	40.13	34.41
95% Confidence Interval	24.81,27.63	24.30,27.20	25.23,55.03	25.83,42.99
Standard Deviation	13.034	13.460	36.462	18.056
Median	20.00	20.00	32.00	30.00
Range	12.50,100.00	12.50,100.00	20.00,200.00	16.00,80.00

Table 19 below shows the absolute shift in cylinder axis.

Table 19
Absolute Shift in Axis
All Eyes Treated

Induced Shift	Month 6	Month 9	Month 12
0° to 15°	34%	37%	39%
16° to 30°	19%	16%	16%
31° to 45°	11%	10%	9%
46° to 60°	11%	12%	10%
61° to 75°	12%	12%	15%
76° to 90°	15%	14%	10%

Table 20 presents change in best spectacle visual acuity for all eyes treated.

Table 20
Change in Best Spectacle Corrected Visual Acuity
All Eyes Treated

	Month 1	Month 3	Month 6	Month 9	Month 12
Decrease > 2 lines	2%	1%	1%	1%	0%
Decrease 2 lines	6%	5%	4%	3%	2%
Decrease 1 line	29%	27%	27%	22%	22%
No Change	48%	51%	51%	54%	54%
Increase 1 line	12%	13%	16%	18%	18%
Increase 2 lines	2%	3%	1%	2%	4%
Increase > 2 lines	0%	0%	1%	0%	0%

NOTE: At 6 months, 5% (18/387) of eyes reported greater than or equal to 2 lines loss of BSCVA. Of these 18 eyes, 39% (7/18) reported a BSCVA of 20/20 and 78% (14/18) had a BSCVA of 20/25 or better. All but one eye (17/18) had 20/32 or better with no eye worse than 20/40. In regards to patient satisfaction specifically for these 18 eyes, half (9/18) reported being "Satisfied" or "Very Satisfied" while 28% or 5 eyes reported being "Dissatisfied" or "Very Dissatisfied".

Subjects were asked to complete a questionnaire that allowed them to report any symptoms or complaints they had regarding their vision or ocular comfort following the procedure. Results for the subjective responses to these questionnaires at 6, 9, and 12 months post treatment are provided in Table 21.

Table 21
Subject Symptoms
All Eyes Treated

	None	Mild	Moderate	Marked	Very Severe
Light Sensitivity					
Preop	69%	17%	9%	4%	1%
Month 6	52%	33%	11%	3%	1%
Month 9	57%	28%	12%	3%	1%
Month 12	54%	31%	10%	3%	1%
Headaches					
Preop	84%	12%	2%	1%	1%
Month 6	84%	10%	4%	1%	1%
Month 9	84%	9%	4%	1%	2%
Month 12	85%	10%	4%	1%	1%
Pain					
Preop	95%	4%	1%	0%	0%
Month 6	91%	7%	1%	1%	1%
Month 9	92%	6%	1%	0%	1%
Month 12	96%	3%	0%	1%	1%
Redness					
Preop	83%	13%	3%	<1%	1%
Month 6	81%	13%	4%	1%	1%
Month 9	77%	15%	6%	2%	1%
Month 12	83%	13%	3%	1%	<1%
Dryness					
Preop	77%	15%	8%	1%	0%
Month 6	58%	28%	8%	6%	1%
Month 9	60%	27%	8%	5%	1%
Month 12	61%	27%	7%	4%	1%
Excessive Tearing					
Preop	87%	6%	4%	2%	1%
Month 6	85%	9%	3%	2%	1%
Month 9	83%	11%	3%	1%	2%
Month 12	89%	6%	3%	1%	1%
Burning					
Preop	88%	9%	2%	1%	<1%
Month 6	83%	12%	3%	2%	<1%
Month 9	82%	11%	5%	2%	<1%
Month 12	85%	12%	2%	1%	0%
Gritty, Scratchy, or Sandy Feeling					
Preop	83%	14%	2%	0%	0%
Month 6	79%	13%	4%	3%	0%
Month 9	82%	14%	3%	1%	1%
Month 12	81%	14%	4%	0%	1%

Table 21
Subject Symptoms
All Eyes Treated
(Continued)

	None	Mild	Moderate	Marked	Very Severe
Glare					
Preop	74%	18%	6%	1%	1%
Month 6	56%	28%	11%	5%	1%
Month 9	58%	28%	8%	4%	2%
Month 12	60%	25%	11%	2%	2%
Halos					
Preop	90%	7%	2%	2%	<1%
Month 6	63%	21%	8%	5%	2%
Month 9	66%	21%	9%	2%	2%
Month 12	65%	21%	8%	3%	2%
Blurred Vision					
Preop	67%	13%	11%	7%	2%
Month 6	52%	28%	12%	6%	3%
Month 9	59%	22%	12%	5%	2%
Month 12	63%	22%	10%	4%	1%
Double Vision					
Preop	90%	5%	5%	1%	0%
Month 6	67%	17%	8%	6%	3%
Month 9	74%	13%	7%	4%	1%
Month 12	77%	14%	5%	3%	1%
Fluctuation of Vision					
Preop	84%	12%	3%	1%	0%
Month 6	54%	29%	8%	7%	1%
Month 9	60%	25%	7%	5%	3%
Month 12	60%	28%	7%	4%	1%
Variation in Vision in Bright Light					
Preop	74%	16%	8%	2%	<1%
Month 6	55%	30%	10%	3%	1%
Month 9	62%	24%	8%	5%	1%
Month 12	58%	28%	9%	4%	1%
Variation in Vision in Normal Light					
Preop	85%	11%	4%	<1%	<1%
Month 6	70%	19%	9%	1%	1%
Month 9	71%	17%	8%	3%	1%
Month 12	70%	22%	6%	2%	1%
Variation in Vision in Dim Light					
Preop	75%	14%	8%	1%	1%
Month 6	54%	26%	13%	5%	1%
Month 9	60%	19%	12%	5%	3%
Month 12	57%	25%	11%	4%	3%

Table 21
Subject Symptoms
All Eyes Treated
(Continued)

	None	Mild	Moderate	Marked	Very Severe
Night Driving Vision Problems					
Preop	64%	19%	12%	2%	2%
Month 6	55%	24%	12%	6%	4%
Month 9	59%	23%	7%	6%	4%
Month 12	60%	24%	7%	5%	4%
Other Symptoms					
Preop	96%	1%	2%	1%	0%
Month 6	96%	2%	1%	<1%	1%
Month 9	97%	2%	1%	0%	<1%
Month 12	96%	1%	1%	1%	<1%

NOTE: At the 12 month interval, ≥ 5% of patients reported a postoperative increase in moderate to marked ratings for the following symptoms: glare, halos, fluctuation of vision, and variation in vision in dim light. There was no significant increase (≥ 5%) in symptoms with very severe rating.

XI. CONCLUSIONS DRAWN FROM THE STUDIES

The data in this application support reasonable assurance of the safety and efficacy of this device when used in accordance with the indications for use.

XII. PANEL RECOMMENDATION

On November 20, 2001, the Ophthalmic Devices Advisory Panel recommended that the premarket approval application for the Refracec ViewPoint™ CK℠ System for the treatment of hyperopia be considered approvable with conditions. The conditions recommended by the panel were to:

1. Revise the indications for use statement as follows:
   - Conductive keratoplasty treatment is for the temporary reduction of spherical hyperopia in the range of:
     +0.75 to +3.25 Diopters (D) of cycloplegic spherical hyperopia
     -0.75 D or less of refractive astigmatism
     +0.75 to +3.00 D cycloplegic spherical equivalent
   - In patients with ≤ 0.50 D difference between preoperative manifest and cycloplegic refractions.
   - In patients 40 years of age or older.
2. Revise the labeling.
3. Continue the clinical study out to 24 months and submit the data to FDA for review as a post market study.

XIII. CDRH DECISION

Following the panel meeting on November 30, 2001, FDA did not issue a deficiency letter to Refractec, Inc., but worked interactively with Refractec regarding the remaining issues. Generally, FDA agreed with the Panel's recommendations, and Refractec agreed to continue follow-up of subjects in their clinical study per the protocol out to the 24-month examination. Refractec submitted responses that adequately addressed all of FDA's concerns and labeling changes.

The applicant's manufacturing facilities were inspected and found to be in compliance with the Quality Systems Regulation (21 CFR 820). CDRH issued an approval order on April 11, 2002.

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XIV. APPROVAL SPECIFICATIONS

- Postapproval Requirements and Restrictions: see Approval Order.
- Hazards to Health from Use of the Device: see Indications, Contraindications, Warnings, Precautions, and Adverse Events in the labeling.
- Directions for Use: see labeling.