SUMMARY OF SAFETY AND EFFECTIVENESS DATA
FOR A SUPPLEMENTAL PREMARKET APPROVAL APPLICATION

I. GENERAL INFORMATION

Device Generic Name:	Ophthalmic Excimer Laser System
Device Trade Name:	VISX STAR S4 IR™ Excimer Laser System with Variable Spot Scanning (VSS™) and WaveScan WaveFront® System
Applicant's Name and Address:	VISX, Incorporated 3400 Central Expressway Santa Clara, CA 95051-0703
Date of Panel Recommendation:	None
Premarket Approval (PMA) Application Number:	P930016/S21
Date of Notice of Approval to Applicant:	August 30, 2005

The STAR Excimer Laser was originally approved on March 27, 1996, under PMA P930016, for the limited indication for myopic photorefractive keratectomy (PRK) using a 6.0 mm ablation zone in patients 18 years of age or older with 1.0 to 6.0 diopters (D) of myopia with astigmatism of ≤ 1.0 D whose refractive change for one year prior to treatment is within ± 0.5 D.

This clinical indication was expanded in supplements 3 (approved on April 24, 1997), 5 (approved on January 29, 1998), 7 (approved November 2, 1998), and 10 (approved October 18, 2000) to include PRK in patients 21 years of age or older in PRK treatments for the reduction or elimination of myopia (nearsightedness) of between 0 and -12.0 D spherical myopia at the spectacle plane and up to -4.0 D of astigmatism, hyperopia (sphere only) of between +1.0 and +6.0 D spherical equivalent with no more than 1.0 D of refractive astigmatism, and hyperopia between +0.5 and +5.0 D sphere at the spectacle plane with refractive astigmatism from +0.5 to +4.0 D with a maximum manifest refraction spherical equivalent (MRSE) of +6.0 D. On November 19, 1999 (P990010), the clinical indication was further expanded to include laser in situ keratomileusis (LASIK) treatments in patients 18 years of age or older for the reduction or elimination of myopia (nearsightedness) from 0 to -14.0 D with or without -0.50 to -5.0 D of astigmatism. Supplement 12 (approved April 27, 2001) expanded the indication to include patients 21 years of age or older in treatments for the reduction or elimination of naturally occurring hyperopia between +0.5 D and +5.0 D sphere at the spectacle plane with or without refractive astigmatism up to +3.0 D with a maximum manifest refraction spherical equivalent (MRSE) of +6.0 D. Supplement 14 (approved November 16, 2001) expanded the indication for the reduction or elimination of naturally occurring mixed astigmatism where the magnitude of cylinder (≤ 6.0 D at the spectacle plane) is greater than the magnitude of sphere and the cylinder and sphere have opposite signs. Supplement 15 (approved August 7, 2002) added an auto-centering function to the ActiveTrak™ eye tracking system and changed the trade name to the STAR S4. Supplement 16 (approved May 23, 2003) expanded the clinical indication for wavefront-guided LASIK for the reduction or elimination of myopic astigmatism up to - 6.00 D MRSE, with cylinder between 0.00 and -3.00 D. Supplement 18 (approved June 7, 2004) introduced the Fourier Transform Analysis of Hartmann-Shack data in WaveScan Version 3.50. Supplement 17 (approved December 14, 2004) expanded the clinical indication for wavefront-

with cylinder between 0.00 and 2.00 D. Supplement 19 (approved February 18, 2005) added an iris registration system, an ozone compensation system, and changed the trade name to the STAR S4 IR™ Excimer Laser System. Supplement 20 (approved March 17, 2005) expanded the clinical indication for wavefront-guided LASIK for the reduction or elimination of naturally occurring mixed astigmatism when the magnitude of cylinder (from 1.0 to 5.0 D) is greater than the magnitude of sphere and the cylinder and sphere have opposite signs. Supplement 22 (approved May 2, 2005) included refinements to the iris registration system.

The sponsor submitted this supplement to further expand the clinical indications to include a higher range of wavefront-guided myopia and myopic astigmatism. The updated clinical data to support the expanded indication is provided in this summary. For more information on the data which supported the approved indications, the summaries of safety and effectiveness data (SSED) for P930016 and P990010 should be referenced. Written requests for copies of the SSED can be obtained from the Dockets Management Branch (HFA-305), Food and Drug Administration, 5630 Fishers Lane, rm. 1061, Rockville, MD 20857 under Docket # 97M-0084 (P930016 and S3), Docket # 99M-0293 (S5), Docket # 00M-1391 (S7), Docket # 01M-0015 (S10), Docket # 01M-0305 (S12), Docket # 01M-0522 (S14), Docket # 03M-0333 (S16), Docket # 05M-0055 (S17), Docket # 05M-0151 (S20), and Docket # 00M-1447 (P990010) or you may download the files from the internet sites http://www.fda.gov/cdrh/pdf/p930016.pdf and http://www.fda.gov/cdrh/pdf/p990010.pdf.

II. INDICATIONS FOR USE

The STAR S4 IR™ Excimer Laser System with Variable Spot Scanning (VSS™) and WaveScan WaveFront® System is indicated for wavefront-guided laser assisted in situ keratomileusis (LASIK):

- for the reduction or elimination of myopia and myopic astigmatism from -6.00 to -11.00 D MRSE, with cylinder between 0.00 and -3.00 D;
- in patients 21 years of age or older, and
- in patients with documented evidence of a change in manifest refraction of no more than 1.00 D (in both cylinder and sphere components) for at least one year prior to the date of pre-operative examination.

III. CONTRAINDICATIONS

Laser refractive surgery is contraindicated:

- in patients with collagen vascular, autoimmune or immunodeficiency diseases.
- in pregnant or nursing women.
- in patients with signs of keratoconus or abnormal corneal topography
- in patients who are taking one or both of the following medications: isotretinoin (Accutane®) or amiodarone hydrochloride (Cordarone®).

IV. WARNINGS AND PRECAUTIONS

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

V. DEVICE DESCRIPTION

A. WaveScan WaveFront® System

The WaveScan WaveFront System is an integral part of this approval. It is a class III accessory device and has a separate user manual. It is a diagnostic instrument indicated for the automated measurement, analysis, and recording of refractive errors of the eye: including myopia, hyperopia, astigmatism, coma, spherical aberration, trefoil, and other higher order aberrations through sixth order, and for displaying refractive data of the eye to assist in prescribing refractive correction.

The WaveScan WaveFront System measures the refractive error and wavefront aberrations of the human eye using a Hartmann-Shack wavefront sensor. The measurements can be used to determine regular (sphero-cylindrical) refractive errors and irregularities (aberrations) that cause decreased or blurry vision in the human eye.

The function of the Hartmann-Shack sensor is to measure the refractive error of the eye by evaluating the deflection of rays emanating from a small beam of light projected onto the retina. To control the natural accommodation of the eye during WaveScan® imaging, the system incorporates a fogged fixation target.

The WaveScan System optical head projects a beam of light onto the retina. The light reflects back through the optical path of the eye and into the wavefront device. The reflected beam is imaged by a lenslet array onto the charge-coupled device (CCD). Each lens of the array gathers light information (deflection information) from a different region of the pupil to form an image of the light that passes through that region of the pupil. An array of spots is imaged on the CCD sensor. The system compares the locations of the array of spots gathered from the CCD to the theoretical ideal (the ideal plane wave).

The WaveScan System software uses these data to compute the eye's refractive errors and wavefront aberrations using Fourier Transform analysis. The system displays the refractive errors and wavefront aberrations as the optical path difference (OPD) between the measured outgoing wavefront and the ideal plane wave. The WaveScan system software subtracts the refractive errors from the wavefront errors map and displays the higher order aberrations as OPD errors. Regions of the pupil with positive OPD are in front of the ideal plane wave and areas with negative OPD are behind the ideal plane wave.

1. Data Collection

   The eye of the patient is centered in the instruments field of view and the image of the eye is brought in focus. As the patient fixates on the target, the fogging system is engaged to optically adjust the position of the target beyond the far point of the patient. This forces the patient to relax their accommodative system, so that the refraction of the eye is measured accurately. There is no pharmaceutical eye dilation required for the patient.

2. Wavefront Measurement

   During the data capture, four images are captured from the Hartmann-Shack camera within a short interval of time. The pupil camera of the instrument captures the image of the eye during the same time interval. The spot pattern images are processed to

reconstruct the wavefront and if two or more of them pass the acceptance criteria, the valid measurements are averaged to yield the final measurement for the examination.

3. Registration

   Internal instrument calibration establishes the coordinate transformation between the pupil imaging camera and the Hartmann-Shack camera, so that the wavefront map can be correctly centered at the center of the pupil during the measurement.

4. Treatment Design

   The target treatment shape is automatically calculated by the WaveScan instrument from the wavefront data. Once the target shape is established, VSS™ software module generates the commands for the laser to create the target shape on the cornea. Corneal geometry, represented by the keratometry values, is taken into account in computing the laser instructions.

   CustomVue™ ablations for high myopia and myopic astigmatism are approved for an optical zone of 6.0 mm, and an ablation zone of 8.0 mm. No treatments with optical zones greater than 6.0 mm were attempted in the U.S. Clinical Trial. All treatments utilized a variable repetition rate to a maximum of 20 Hz. CustomVue ablations for this PMA are locked out above -12.0 D spherical equivalent as measured by manifest refraction.

   The final commercial release versions for CustomVue are WaveScan software version 3.62 together with STAR software version 5.10. The WaveScan software is capable of calculating treatments with an optical zone up to 9.0 mm with total ablation zone up to 9.5 mm.

5. Data Transfer

   The treatment files produced by the WaveScan® instrument contain information about the patient, such as name, ID and refractive data and the set of instructions for the VISX STAR laser. They are copied onto a USB flash drive or floppy disk for transfer to the laser. The files are encrypted to prevent data tampering or data corruption.

Features and components of the WaveScan WaveFront System include:

- Computer Control
- PC and Monitor
- Isolation Transformer
- Power Supply
- LED
- Optical Head
- Printer
- Motorized table

B. Microkeratome

The LASIK procedure required the use of a commercially available keratome that has been cleared for marketing via premarket notification. Three different keratomes were used in this study. Two devices consisted of a sterilization/storage tray which includes the shaper head, a left/right eye adapter, suction ring, suction handle, blade handling pin, and corneal reference marker. The instrument motor, tonometer, cleaning brush, disposable blades, power/suction supply unit with vacuum and motor footswitches and power cords are provided as separate components in an accessory stand and equipment suitcase which complete the system. The third device was a femtosecond ophthalmic surgical laser that creates a LASIK flap through precise individual microphotodisruptions of tissue, created by tightly focused ultrashort pulses which are delivered through a disposable applanation lens while fixating the eye under very low vacuum.

C. STAR S4 IR™ Excimer Laser System

The STAR S4 IR laser system is a 193 nm excimer laser system that delivers spatially scanning ultraviolet pulses of variable diameters and slits on to the cornea. The range of diameters and slits available during treatments are 0.65 mm to 6 mm. An auto-centering dual camera infrared eye tracking system (ActiveTrak™), together with the delivery system, aligns the treatment to the eye, and compensates for eye movements during laser correction to maximize the corneal reshaping accuracy. An operating microscope is used to observe the patient procedures and to facilitate accurate focus and laser beam alignment. A debris-removal system is designed to evacuate the debris plume that occurs during ablation. The operating chair and fixation LED align the patient, while a video camera and monitor records the patient treatment.

The variable spot scanning (VSS™) feature of the laser, used for CustomVue™ treatments delivers variable diameter ultraviolet pulses to precise locations by the scanning delivery system. The VSS algorithm optimizes the ablation pattern by choosing the best combination of beam diameters and locations to achieve a target shape. VSS expands the laser capability to achieve a broader spectrum of ablation shapes than conventional treatments because the conventional algorithm optimizes only the diameter for myopic treatments and slits for hyperopic treatments.

Conventional STAR treatments utilize sphere, cylinder and axis components which are entered manually into the laser by the operator to generate the ablation treatment. CustomVue™ treatment information is generated on the WaveScan® system and transferred to the STAR S4 IR Excimer Laser System. The transferred information includes patient information, eye and refraction information, image of the eye, eye alignment information, and ablation instructions to the laser

for beam diameters and the exact locations of the beam on the cornea. The VISX Treatment card defines the number and the types of treatments available.

Wavefront-guided treatments using the STAR S4 IR™ and WaveScan Systems utilize an automated iris registration system. The angle of rotation of the patient's eye under the laser is determined by comparing features of the iris on the WaveScan image to the same features located in the image of the iris taken using the STAR S4 IR camera. The treatment is rotated to align precisely with the rotation of the patient's eye under the laser. In supplement 19, VISX received approval allowing the iris registration (IR) modification to be used with all existing approved indications. Minor software improvements to the IR subsystem were also approved in supplement 22. Although the IR subsystem was not used in this clinical trial, its use should not introduce new safety or effectiveness problems in the wavefront-guided LASIK treatment of high myopia or myopic astigmatism.

The STAR S4 IR laser software also contains a refinement to the method of STAR laser beam energy control by inclusion of an ozone compensation system.

Features and components of the STAR S4 IR System include:

- Excimer Laser
- Gas Management System
- Laser Beam Delivery System
- Patient Management System
- Computer Control
- VISX Treatment Card

VI. ALTERNATIVE PRACTICES AND PROCEDURES

There are currently several other alternatives for the correction of high myopia:

- Automated lamellar keratoplasty (ALK)
- Contact Lenses
- Conventional Laser in-situ keratomileusis (LASIK - based on phoropter refraction)
- Conventional Photorefractive Keratectomy (PRK - based on phoropter refraction)
- Radial Keratotomy (RK)
- Spectacles
- Other refractive surgical procedures including corneal implants or phakic IOLs.

Each alternative has its own advantages and disadvantages. A prospective patient should fully discuss with his/her care provider these alternatives in order to select the correction method that best meets his/her expectation and lifestyle.

VII. MARKETING HISTORY

The VISX STAR™ Excimer Laser System has been distributed in 62 countries (Argentina, Aruba, Austria, Australia, Belgium, Bolivia, Brazil, Bulgaria, Canada, Chile, China, Colombia, Cyprus, Czech Republic, Dijibouti, Dominican Republic, Dubai, Ecuador, Egypt, Finland, France, Germany, Greece, Guatemala, Hong Kong, Hungary, Indonesia, India, Ireland, Israel, Italy, Jamaica, Japan, Korea, Kuwait, Mexico, The Netherlands, New Zealand, Norway, Pakistan, Paraguay, Peru, Philippines, Portugal, Romania, Russia, Russia-Kazakhstan, Saudi Arabia,

Singapore, Slovak Republic, Spain, Sweden, Switzerland, Taiwan, Thailand, Turkey, Ukraine, United Kingdom, the United States, Uruguay, Venezuela and Vietnam). The VISX STAR Excimer Laser System has not been withdrawn from any country or market for reasons of safety or effectiveness.

The WaveScan WaveFront® System has been distributed in approximately 44 countries (Argentina, Aruba, Australia, Austria, Brazil, Bulgaria, Canada, Chile, China, Colombia, Cyprus, Czech Republic, Dominican Republic, Egypt, Finland, France, Germany, Greece, India, Indonesia, Ireland, Israel, Italy, Japan, Korea, Kuwait, Mexico, The Netherlands, Philippines, Portugal, Russia, Saudi Arabia, Singapore, Spain, Sweden, Taiwan, Thailand, Turkey, UAE, Ukraine, United Kingdom, the United States, Uruguay and Vietnam). The WaveScan WaveFront System has not been withdrawn from any country or market for reasons of safety or effectiveness.

VIII. POTENTIAL ADVERSE EFFECTS OF THE DEVICE ON HEALTH

Potential adverse reactions associated with LASIK include: loss of best spectacle corrected visual acuity (BSCVA), worsening of patient complaints such as double vision, sensitivity to bright lights, increased difficulty with night vision, fluctuations in vision, increase in intraocular pressure, corneal haze, secondary surgical intervention, corneal infiltrate or ulcer, corneal epithelial defect, corneal edema, problems associated with the flap including a lost, misplaced or misaligned flap, retinal detachment, and retinal vascular accidents.

Please refer to the complete listing of adverse events and complications observed during the clinical study which are presented in Tables 19 and 20 of the Summary of Clinical Studies section.

IX. SUMMARY OF PRECLINICAL STUDIES

A. STAR™ Excimer Laser System

For a summary of non-clinical studies (excluding hazard analysis and software testing) for the STAR Excimer Laser System, refer to the SSED of the original PMA #P930016.

B. WaveScan Wavefront® System

1. Hazard Analysis

   Hazard Analysis and Software Testing was conducted for the combined use of the WaveScan WaveFront System and the STAR Excimer Laser System. Hazard Analysis includes 3 separate fault tree analyses (FTAs): WaveScan 3.62, Topographer Measurement for Custom Contoured Ablation Patterns Method (C-CAP) Treatments and STAR software 5.0 version with C-CAP and WavePrint treatment. The WaveScan FTA encompasses the process from patient measurement to the generation of treatment table files. The Topographer FTA encompasses the process from patient measurement to treatment printout. The STAR FTA encompasses all previously identified fault and mitigating circumstances identified with any given treatment process. The software test procedures covered all aspects of new software functionality and performance. All test procedures were completed. The Hazard Analysis and software test report indicated no new hazards affecting safety or effectiveness.

2. Testing for Measurement of Refractive Errors of the Eye with WaveScan Wavefront System

   A bench top study for the measurement of total refractive errors of the eye, including myopia, astigmatism, coma, spherical aberrations, trefoil and other higher order aberrations through sixth order, and Software Testing was conducted for the WaveScan WaveFront® System. The test was designed to measure conventional aberrations in a VISX model eye and in 8 phase plates with different combinations of Zernike aberrations. The data from this study indicated the VISX WaveScan WaveFront System provides an adequate and reliable measurement of total refractive errors of the eye, including myopia, astigmatism, coma, spherical aberration, trefoil and other higher order aberration through sixth order.

3. Profilometry of Ablation

   As a part of this PMA, VISX validated the accuracy of WaveScan-derived high myopic corrections by performing a variety of test ablations on plastic surfaces, with and without ablation nomogram adjustments. All ablations were scanned with a surface profilometer and showed very good agreement to theoretical targets.

X. SUMMARY OF CLINICAL STUDIES

A clinical study of LASIK treatment, with the VISX STAR S4™ Excimer Laser System with Variable Spot Scanning and WaveScan-derived ablation targets for the correction of high myopia and myopic astigmatism, was conducted under IDE G010048. The data from this study are presented as a basis for consideration and approval. Specifically, safety and effectiveness outcomes at 6 months postoperatively were assessed, as stability is reached by that time. A standardized physician adjustment of -0.5D sphere offset and +4% nomogram boost were used by all sites to increase the ablation efficiency by approximately 10% for all eyes. The use of these adjustments raised no safety or effectiveness issues. A PMA supplement has been submitted to incorporate these adjustments into the WaveScan® software and automatically apply them to high myopia treatments. The IDE study is described in detail as follows:

A. Study Objective

The objective of this clinical investigation was to demonstrate that LASIK treatment with the VISX STAR Excimer Laser System with Variable Spot Scanning and WaveScan derived ablation targets is safe and effective for the correction of high myopia with and without astigmatism.

B. Study Design

This was a prospective, multi-center, open-label, non-randomized study where the primary control was the preoperative state of the treated eye (i.e., comparison of pretreatment and post-treatment visual parameters in the same eye).

C. Inclusion and Exclusion Criteria

Enrollment in the study on the effect of LASIK treatment with the VISX STAR Excimer Laser System using Variable Spot Scanning technology with WaveScan® derived ablation targets, was limited to those subjects who met the following inclusion criteria in their operative eye(s):

- Male or female subjects of any race, and at least 21 years old at the time of the pre-operative examination.
- Myopia up to -11.0 D, with cylinder up to -6.0 D, and MRSE between -6.0 and -14.0 D at the spectacle plane, or myopic astigmatism less than -6.0 D MRSE, with cylinder between -3.0 D and -6.0 D as measured at the spectacle plane.
- Best spectacle corrected visual acuity (BSCVA) of 20/20 or better.
- Wavefront measurement diameter $\geq$ 5.0 mm.
- Manifest refraction within ± 0.75 D of WaveScan refraction (sphere and cylinder) and no more than 15 degrees of difference between axes for eyes with cylinder greater than 0.50 D.
- Manifest refraction within ± 0.75 D of Cycloplegic refraction (sphere).
- WaveScan refraction within ± 0.75 D of Cycloplegic refraction (sphere and cylinder) and no more than 15 degrees of difference between axes for eyes with cylinder greater than 0.50 D.

- Pachymetric measurement minus the maximal depth ablated (as described by the VISX software) added to the flap thickness is greater than or equal to 250 microns (i.e., Pachymetry — [Depth of ablation + Flap thickness] $\geq$ 250 microns).
- Eyes that demonstrated refractive stability confirmed by a change of less than or equal to 1.0 diopter (sphere and cylinder) at an exam at least 12 months prior to the baseline examination. The astigmatic axis must also be within 15 degrees for eyes with cylinder greater than 0.50 D.
- Contact lens wearers who removed soft lenses at least 1 week prior and rigid (Gas permeable and PMMA) lenses at least 2 weeks prior to baseline measurements. At that baseline examination, cycloplegic and manifest refractions as well as corneal topography were obtained. If the investigator determined that the topography was within normal limits, surgery was scheduled at least one week after the initial exam, with no contact lens wear permitted prior to the surgery. If on the day of scheduled surgery, for the operative eye, repeat central keratometry readings and manifest refraction spherical equivalents did not differ significantly from the initial exam measurements (by more than 0.50 diopter), surgery proceeded. If the refractive change exceeded this criterion, the surgery was rescheduled after refractive stability was achieved.
- Planned treatment such that the anticipated post-operative keratometry value in any meridian will be $\geq$ 33 D. Anticipated post-operative keratometry values will be calculated by multiplying the MRSE by 0.8, and subtracting that value from the mean pre-operative keratometry value. In other words, [((Flat K + Steep K) x 0.5) - (MRSE x 0.8)] $\geq$ 33 D.
- Subjects willing and capable of returning for follow-up examinations for the duration of the study.

Patients were not permitted to enroll in the study if they met any of the following exclusion criteria:

- Female subjects who were pregnant, breast-feeding or intended to become pregnant over the course of the study.
- Subjects whose fellow eye did not meet all inclusion criteria or fall within approved indications for treatment using the VISX STAR Excimer Laser.
- Subjects who used concurrent topical or systemic medications which might have impaired healing, including but not limited to: antimetabolites, isotretinoin (Accutane®) within 6 months of treatment, and amiodarone hydrochloride (Cordarone®) within 12 months of treatment.

  NOTE: The use of topical or systemic corticosteroids, whether chronic or acute, was deemed to adversely affect healing and subjects using such medication were specifically excluded from eligibility.
- Subjects who had a history of any of the following medical conditions, or any other condition that could have affected wound healing: collagen vascular disease, autoimmune disease, immunodeficiency diseases, ocular herpes zoster or simplex, endocrine disorders (including, but not limited to unstable thyroid disorders and diabetes), lupus, and rheumatoid arthritis.

  NOTE: The presence of diabetes (either type 1 or 2), regardless of disease duration, severity or control, specifically excluded subjects from eligibility.

- Subjects who had a history of prior intraocular or corneal surgery (including cataract extraction), active ophthalmic disease or abnormality (including, but not limited to, blepharitis, recurrent corneal erosion, dry eye syndrome, neovascularization > 1mm from limbus), clinically significant lens opacity, clinical evidence of trauma (including scarring), at risk for developing strabismus, evidence of glaucoma, or propensity for narrow angle glaucoma in the operative eye(s).

  NOTE: This included any subject with open angle glaucoma, regardless of medication regimen or control. Additionally, any subject with an IOP greater than 21 mm Hg at baseline was specifically excluded from eligibility.

- Subjects who had evidence of keratoconus, corneal irregularity, or abnormal videokeratography in the operative eye(s).
- Subjects who had known sensitivity or inappropriate responsiveness to any of the medications used in the post-operative course.
- Subjects who were participating in any other clinical trial.

D. Study Plan, Patient Assessments, and Efficacy Criteria

All subjects were expected to return for follow-up examinations at 1 and 7 days, and 1, 3, 6, 9, 12 and 24 months postoperatively.

Subjects were permitted to have second eyes (fellow eyes) treated at the discretion of the investigator at the same time as the first eye (primary eyes) or after the primary eye treatment.

- In addition, subjects were eligible for retreatment no sooner than 3 months after treatment with submission of appropriate clinical data, planned treatment, and agreement of the medical monitor in advance.

All study treatments were conducted using a 6 mm optical zone and an 8 mm ablation zone with intention of full correction to emmetropia.

The parameters measured during the study were:

- At 24 hours and 1 week: subjective patient symptoms, UCVA, and anterior segment examination by biomicroscopy. Manifest refraction and BSCVA were also conducted on each patient at the 1-week visit. Adverse events, complications, medications and other clinical findings were also noted.
- At 1 and 3 months: visual acuity (uncorrected, and best spectacle corrected), manifest refraction, keratometry, videokeratography, WaveScan® measurement, contrast sensitivity, applanation tonometry, anterior segment examination by biomicroscopy, and a subjective questionnaire. Dim pupil size was also conducted on each patient subject at the 3-month visit only. Adverse events, complications, medications and other clinical findings were also noted.
- At 6, 9, 12, and 24 months: visual acuity (uncorrected and best spectacle corrected), manifest refraction, keratometry, corneal videokeratography, WaveScan measurement, contrast sensitivity, applanation tonometry, anterior segment examination by biomicroscopy, and a subjective questionnaire. After cycloplegia, a refraction, dilated media and fundoscopic examination were performed. Adverse events, complications, medications, and other clinical findings were noted as appropriate. During the 9 month post-operative examination, contrast sensitivity, the subjective questionnaire, cycloplegia and post-cycloplegia testing were not required.

The primary efficacy variables for this study were: improvement of UCVA, predictability of manifest refraction spherical equivalent (MRSE), and refractive stability.

E. Study Period and Investigational Sites and Demographics

1. Study Period and Investigational Sites

Ninety-four (94) subjects were treated between March 29, 2004 and August 5, 2004. The database for this PMA supplement reflected data collected through May 2, 2005 and included 184 eyes. There were 7 investigational sites that provided eligible data for analysis.

2. Demographics

Of the184 treated eyes, 46.7% (86/184) were from male subjects and 53.3% (98/184) were from female subjects. Furthermore, 73.4% (135/184) were from Caucasians, 2.2% (4/184) were from African Americans, 9.8% (18/184) were from Asian/Pacific Islanders, and 3.8% (7/184) were of other races. The remaining 10.9% (20/184) of eyes were from subjects who identified themselves as Hispanic. The left eye was treated in 50% (92/184) of the cases and the right eye was treated in 50% (92/184) of the cases. The mean age of the subjects treated was 36 years with a range from 23 to 55.

Table 1 presents demographic information for the three analysis cohorts.

Table 1: Demographic Information

		All Eyes (N=184)		Spherical Myopia (N=83)		Myopic Astigmatism (N=101)	
Category	**Classification**	**n**	**%**	**n**	**%**	**n**	**%**
Gender	Male	86	46.7	40	48.2	46	45.5
	Female	98	53.3	43	51.8	55	54.5
Race	Caucasian	135	73.4	60	72.3	75	74.3
	Asian/Pacific Islander	18	9.8	7	8.4	11	10.9
	African American	4	2.2	4	4.8	0	0.0
	Native American/ Alaskan Native	0	0.0	0	0.0	0	0.0
	Hispanic	20	10.9	6	7.2	14	13.9
	Other*	7	3.8	6	7.2	1	1.0
Eyes	Right	92	50.0	43	51.8	49	48.5
	Left	92	50.0	40	48.2	52	51.5
CL History	None	25	13.6	9	10.8	16	15.8
	Soft	137	74.5	71	85.5	66	65.3
	RGP/PMMA	22	12.0	3	3.6	19	18.8
Age (in Years)	Mean	35.8		34.3		37.1	
	Standard Deviation	± 7.4		± 6.1		± 8.2	
	(Minimum, Maximum)	(23, 55)		(23, 46)		(23, 55)	

*"Other" classifications of race include: Hispanic/American Indian, Persian, and Indian

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F. Data Analysis and Results

1. Preoperative Characteristics

Tables 2 and 3 contain a summary of the preoperative manifest refractive error stratified by sphere or spherical equivalent and cylinder, expressed in minus cylinder notation. All refractions were measured at 4 meters and adjusted to a standard vertex distance (12.5 mm) and optical infinity (by subtracting 0.25 D from the spherical component of the refraction) for data analysis and presentation.

Table 2: Pre-Operative Refractive Error Stratified by Manifest Sphere and Cylinder For All Eyes (N=184)

	Cylinder (D)													
	0 to -0.5		< -0.5 to -1		< -1 to -2		< -2 to -3		< -3 to -4		< -4 to -5.25		Total	
Sphere (D)	n	%	n	%	n	%	n	%	n	%	n	%	n	%
< -5 to -6	0	0.0	0	0.0	3	1.6	1	0.5	2	1.1	2	1.1	8	4.3
< -6 to -7	13	7.1	11	6.0	7	3.8	10	5.4	3	1.6	0	0.0	44	23.9
< -7 to -8	30	16.3	6	3.3	14	7.6	4	2.2	2	1.1	0	0.0	56	30.4
< -8 to -9	23	12.5	8	4.3	7	3.8	2	1.1	0	0.0	0	0.0	40	21.7
< -9 to -10	8	4.3	4	2.2	7	3.8	1	0.5	0	0.0	0	0.0	20	10.9
< -10 to -11.25	9	4.9	4	2.2	3	1.6	0	0.0	0	0.0	0	0.0	16	8.7
Total	83	45.1	33	17.9	41	22.3	18	9.8	7	3.8	2	1.1	184	100

Table 3: Pre-Operative Refractive Error Stratified by Manifest Spherical Equivalent and Cylinder For All Eyes (N=184)

	Cylinder (D)													
	0 to -0.5		< -0.5 to 1		< -1 to -2		< -2 to -3		< -3 to -4		< -4 to -5.25		Total	
Spherical Equivalent (D)	n	%	n	%	n	%	n	%	n	%	n	%	n	%
< -6 to -7	9	4.9	8	4.3	3	1.6	1	0.5	0	0.0	0	0.0	21	11.4
< -7 to -8	27	14.7	7	3.8	8	4.3	9	4.9	2	1.1	1	0.5	54	29.3
< -8 to -9	26	14.1	5	2.7	16	8.7	2	1.1	3	1.6	1	0.5	53	28.8
< -9 to -10	12	6.5	7	3.8	5	2.7	5	2.7	2	1.1	0	0.0	31	16.8
< -10 to -11	7	3.8	3	1.6	6	3.3	1	0.5	0	0.0	0	0.0	17	9.2
< -11 to -12	2	1.1	3	1.6	3	1.6	0	0.0	0	0.0	0	0.0	8	4.3
Total	83	45.1	33	17.9	41	22.3	18	9.8	7	3.8	2	1.1	184	100

2. Postoperative Results

a. Patient Accountability

Of the 184 eyes treated, over 93% accountability was achieved at the 1, 3, 6, 9, and 12-months visits. Table 4 presents subject accountability over time.

Table 4: Subject Accountability

	1 Month		3 Months		6 Months		9 Months		12 Months	
	n	%	n	%	n	%	n	%	n	%
All Eyes										
Available for Analysis	184	100	180	97.8	178	96.7	170	92.4	107	58.2
Discontinued^	0	0.0	0	0.0	0	0.0	0	0.0	2	1.1
Missed Visit	0	0.0	2	1.1	4	2.2	4	2.2	1	0.5
Not yet eligible	0	0.0	0	0.0	0	0.0	6	3.3	68	37.0
Lost to Follow-Up	0	0.0	2	1.1	2	1.1	4	2.2	6	3.3
% Accountability*	**100%**		**97.8%**		**96.7%**		**96.5%**		**93.9%**	
Spherical Myopia										
Available for Analysis	83	100	82	98.8	83	100	73	88.0	46	55.4
Discontinued	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Missed Visit	0	0.0	1	1.2	0	0.0	4	4.8	0	0.0
Not yet eligible	0	0.0	0	0.0	0	0.0	6	7.2	37	44.6
Lost to Follow-Up	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
% Accountability*	**100%**		**98.8%**		**100%**		**94.8%**		**100%**	
Myopic Astigmatism										
Available for Analysis	101	100	98	97.0	95	94.1	97	96.0	61	60.4
Discontinued^	0	0.0	0	0.0	0	0.0	0	0.0	2	2.0
Missed Visit	0	0.0	1	1.0	4	4.0	0	0.0	1	1.0
Not yet eligible	0	0.0	0	0.0	0	0.0	0	0.0	31	30.7
Lost to Follow-Up	0	0.0	2	2.0	2	2.0	4	4.0	6	5.9
% Accountability*	**100%**		**97.0%**		**94.1%**		**96.0%**		**89.7%**	

*% Accountability= [Available for Analysis/(enrolled-discontinued-not yet eligible)] x 100
^2 eyes were discontinued prior to the 12 month visit due to retreatment.

b. Stability of Outcome

Stability of outcome was evaluated for the cohort of eyes with a refraction at each visit through 9 months (n=164). Refractive stability was reached at 6 months and confirmed at 9 months. Over 98% of eyes with exams at 1, 3, 6 and 9 months post-operatively experienced a change in MRSE of ≤ 1.00 D between visits. Table 5 presents refractive stability of eyes with visits at 1, 3, 6, and 9 months post-operatively.

Table 5: Stability of MRSE for Eyes that underwent 1, 3, 6, and 9-Month Exams

	Between 1 and 3 Months	**Between 3 and 6 Months**	**Between 6 and 9 Months**
All Eyes (n=164)			
Change in MRSE by ≤ 1.0 D n, %	161 98.2%	163 99.4	163 99.4
95% CI	(94.7, 99.6)	(96.6, 100.0)	(96.6, 100.0)
Mean Change in MRSE ± SD	-0.08 ± 0.39	-0.04 ± 0.31	-0.02 ± 0.28
95% CI	(-0.14, -0.02)	(-0.09, 0.01)	(-0.07, 0.02)
Spherical Myopia (n=72)			
Change in MRSE by ≤ 1.0 D n, %	70 97.2%	71 98.6	72 100.0
95% CI	(90.3, 99.7)	(92.5, 100.0)	(95.9, 100.0)
Mean Change in MRSE ± SD	-0.08 ± 0.39	-0.07 ± 0.34	-0.04 ± 0.29
95% CI	(-0.17, 0.01)	(-0.15, 0.01)	(-0.11, 0.03)
Myopic Astigmatism (n=92)			
Change in MRSE by ≤ 1.0 D n, %	91 98.9	92 100.0	91 98.9
95% CI	(94.1, 100.0)	(96.8, 100.0)	(94.1, 100.0)
Mean Change in MRSE ± SD	-0.08 ± 0.40	-0.02 ± 0.29	-0.01 ± 0.28
95% CI	(-0.17, 0.00)	(-0.08, 0.04)	(-0.07, 0.05)

c. Effectiveness Outcomes

The data from all one hundred eighty-four (184) eyes of ninety-four (94) subjects who were enrolled and treated in this study were used to evaluate effectiveness. Effectiveness analyses are also presented separately for eyes with spherical myopia (eyes with ≤ 0.5 D preoperative manifest cylinder, n=83), and myopic astigmatism (eyes with > 0.5 D preoperative manifest cylinder, n=101). Vector Analyses were conducted at the point of defined stability, 6-months.

1) Uncorrected Visual Acuity (UCVA)

All eyes were targeted for emmetropia. Tables 6, 7 and 8 present UCVA results over time for all eyes, eyes with spherical myopia, and eyes with myopic astigmatism, respectively. At the 6-month point of stability, more than 84% of all eyes achieved an outcome for UCVA of 20/20 or better.

Table 6: UCVA Over Time for All Eyes (N=184)

	Pre-Op (n=184)	**1 Month (n=184)**	**3 Months (n=180)**	**6 Months (n=178)**	**9 Months (n=170)**	**12 Months (n =107)**
	n % (95% CI)	**n % (95% CI)**	**n % (95% CI)**	**n % (95% CI)**	**n % (95% CI)**	**n % (95% CI)**
20/12.5 or better	0 0.0 (0.0, 1.6)	7 3.8 (1.5, 7.7)	12 6.7 (3.5, 11.4)	26 14.6 (9.8, 20.7)	18 10.6 (6.4, 16.2)	10 9.3 (4.6, 16.5)
20/16 or better	0 0.0 (0.0, 1.6)	95 51.6 (44.2, 59.0)	101 56.1 (48.5, 63.5)	116 65.2 (57.7, 72.1)	103 60.6 (52.8, 68.0)	63 58.9 (49.0, 68.3)
20/20 or better	0 0.0 (0.0, 1.6)	157 85.3 (79.4, 90.1)	147 81.7 (75.2, 87.0)	150 84.3 (78.1, 89.3)	145 85.3 (79.1, 90.3)	92 86.0 (77.9, 91.9)
20/25 or better	0 0.0 (0.0, 1.6)	170 92.4 (87.6, 95.8)	168 93.3 (88.6, 96.5)	166 93.3 (88.5, 96.5)	162 95.3 (90.9, 97.9)	103 96.3 (90.7, 99.0)
20/32 or better	0 0.0 (0.0, 1.6)	175 95.1 (90.9, 97.7)	176 97.8 (94.4, 99.4)	173 97.2 (93.6, 99.1)	165 97.1 (93.3, 99.0)	107 100.0 (97.2, 100.0)
20/40 or better	0 0.0 (0.0, 1.6)	182 98.9 (96.1, 99.9)	177 98.3 (95.2, 99.7)	175 98.3 (95.2, 99.7)	169 99.4 (96.8, 100.0)	107 100.0 (97.2, 100.0)
20/80 or better	0 0.0 (0.0, 1.6)	184 100.0 (98.4, 100.0)	180 100.0 (98.3, 100.0)	178 100.0 (98.3, 100.0)	170 100.0 (98.3, 100.0)	107 100.0 (97.2, 100.0)
20/100 or better	0 0.0 (0.0, 1.6)	184 100.0 (98.4, 100.0)	180 100.0 (98.3, 100.0)	178 100.0 (98.3, 100.0)	170 100.0 (98.3, 100.0)	107 100.0 (97.2, 100.0)
Worse than 20/100	184 100.0 (98.4, 100.0)	0 0 (0.0, 1.6)	0 0 (0.0, 1.7)	0 0 (0.0, 1.7)	0 0 (0.0, 1.7)	0 0 (0.0, 2.8)
Not Reported	0	0	0	0	0	0

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Table 7: UCVA Over Time for Eyes with Spherical Myopia (N=83)

	Pre-Op (n=83)	1 Month (n=83)	3 Months (n=82)	6 Months (n=83)	9 Months (n=73)	12 Months (n=46)
	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)
20/12.5 or better	0 0.0 (0.0, 3.5)	4 4.8 (1.3, 11.9)	8 9.8 (4.3, 18.3)	16 19.3 (11.4, 29.4)	6 8.2 (3.1, 17.0)	7 15.2 (6.3, 28.9)
20/16 or better	0 0.0 (0.0, 3.5)	55 66.3 (55.1, 76.3)	62 75.6 (64.9, 84.4)	70 84.3 (74.7, 91.4)	59 80.8 (69.9, 89.1)	35 76.1 (61.2, 87.4)
20/20 or better	0 0.0 (0.0, 3.5)	79 95.2 (88.1, 98.7)	77 93.9 (86.3, 98.0)	82 98.8 (93.5, 100.0)	72 98.6 (92.6, 100.0)	45 97.8 (88.5, 99.9)
20/25 or better	0 0.0 (0.0, 3.5)	82 98.8 (93.5, 100.0)	80 97.6 (91.5, 99.7)	82 98.8 (93.5, 100.0)	72 98.6 (92.6, 100.0)	46 100.0 (93.7, 100.0)
20/32 or better	0 0.0 (0.0, 3.5)	82 98.8 (93.5, 100.0)	80 97.6 (91.5, 99.7)	82 98.8 (93.5, 100.0)	72 98.6 (92.6, 100.0)	46 100.0 (93.7, 100.0)
20/40 or better	0 0.0 (0.0, 3.5)	82 98.8 (93.5, 100.0)	81 98.8 (93.4, 100.0)	82 98.8 (93.5, 100.0)	72 98.6 (92.6, 100.0)	46 100.0 (93.7, 100.0)
20/80 or better	0 0.0 (0.0, 3.5)	83 100.0 (96.5, 100.0)	82 100.0 (96.4, 100.0)	83 100.0 (96.5, 100.0)	73 100.0 (96.0, 100.0)	46 100.0 (93.7, 100.0)
20/100 or better	0 0.0 (0.0, 3.5)	83 100.0 (96.5, 100.0)	82 100.0 (96.4, 100.0)	83 100.0 (96.5, 100.0)	73 100.0 (96.0, 100.0)	46 100.0 (93.7, 100.0)
Worse than 20/100	83 100.0 (96.5, 100.0)	0 0.0 (0.0, 3.5)	0 0.0 (0.0, 3.6)	0 0.0 (0.0, 3.5)	0 0.0 (0.0, 4.0)	0 0.0 (0.0, 6.3)
Not Reported	0	0	0	0	0	0

Table 8: UCVA Over Time for Eyes with Myopic Astigmatism (N=101)

	Pre-Op (n=101)	1 Month (n=101)	3 Months (n=98)	6 Months (n=95)	9 Months (n=97)	12 Months (n=61)
	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)
20/12.5 or better	0 0.0 (0.0, 2.9)	3 3.0 (0.6, 8.4)	4 4.1 (1.1, 10.1)	10 10.5 (5.2, 18.5)	12 12.4 (6.6, 20.6)	3 4.9 (1.0, 13.7%)
20/16 or better	0 0.0 (0.0, 2.9)	40 39.6 (30.0, 49.8)	39 39.8 (30.0, 50.2)	46 48.4 (38.0, 58.9)	44 45.4 (35.2, 55.8)	28 45.9 (33.1, 59.2)
20/20 or better	0 0.0 (0.0, 2.9)	78 77.2 (67.8, 85.0)	70 71.4 (61.4, 80.1)	68 71.6 (61.4, 80.4)	73 75.3 (65.5, 83.5)	47 77.0 (64.5, 86.8)
20/25 or better	0 0.0 (0.0, 2.9)	88 87.1 (79.0, 93.0)	88 89.8 (82.0, 95.0)	84 88.4 (80.2, 94.1)	90 92.8 (85.7, 97.0)	57 93.4 (84.1, 98.2)
20/32 or better	0 0.0 (0.0, 2.9)	93 92.1 (85.0, 96.5)	96 98.0 (92.8, 99.8)	91 95.8 (89.6, 98.8)	93 95.9 (89.8, 98.9)	61 100.0 (95.2, 100.0)
20/40 or better	0 0.0 (0.0, 2.9)	100 99.0 (94.6, 100.0)	96 98.0 (92.8, 99.8)	93 97.9 (92.6, 99.7)	97 100.0 (97.0, 100.0)	61 100.0 (95.2, 100.0)
20/80 or better	0 0.0 (0.0, 2.9)	101 100.0 (97.1, 100.0)	98 100.0 (97.0, 100.0)	95 100.0 (96.9, 100.0)	97 100.0 (97.0, 100.0)	61 100.0 (95.2, 100.0)
20/100 or better	0 0.0 (0.0, 2.9)	101 100.0 (97.1, 100.0)	98 100.0 (97.0, 100.0)	95 100.0 (96.9, 100.0)	97 100.0 (97.0, 100.0)	61 100.0 (95.2, 100.0)
Worse than 20/100	101 100 (97.1, 100)	0 0 (0.0, 2.9)	0 0 (0.0, 3.0)	0 0 (0.0, 3.1)	0 0 (0.0, 3.0)	0 0 (0.0, 4.8)
Not Reported	0	0	0	0	0	0

2) Accuracy

Tables 9, 10, and 11 present the accuracy of sphere and cylinder over time for all eyes, eyes with spherical myopia, and eyes with myopic astigmatism, respectively. Accuracy of cylinder analysis is limited to eyes with myopic astigmatism.

At 6 months post-operatively, 95.5% (170/178) of all eyes were within 1.0 D of attempted sphere correction, and 91.6% (87/95) were within 1.0 D of attempted cylinder correction.

Table 9: Accuracy of Sphere (to Zero) Component for All Eyes (N=184)

	Pre-op (n=184)	**1 month (n=184)**	**3 months (n=180)**	**6 months (n=178)**	**9 months (n=170)**	**12 months (n=107)**
	n % (95% CI)	**n % (95% CI)**	**n % (95% CI)**	**n % (95% CI)**	**n % (95% CI)**	**n % (95% CI)**
Sphere						
± 0.50 D	0 0.0 (0.0, 1.6)	144 78.3 (71.6, 84.0)	145 80.6 (74.0, 86.1)	141 79.2 (72.5, 84.9)	140 82.4 (75.8, 87.8)	93 86.9 (79.0, 92.7)
± 1.00 D	0 0.0 (0.0, 1.6)	173 94.0 (89.6, 97.0)	171 95.0 (90.7, 97.7)	170 95.5 (91.3, 98.0)	162 95.3 (90.9, 97.9)	103 96.3 (90.7, 99.0)
Mean ± SD	-7.95 ± 1.35	0.15 ± 0.56	0.07 ± 0.57	0.03 ± 0.57	0.01 ± 0.53	-0.04 ± 0.51
Attempted		-7.95	-7.95	-7.98	-7.98	-8.04
Achieved		-8.10	-8.02	-8.01	-7.99	-8.00
% Achieved		102.1	101.1	100.5	100.4	99.4

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Table 10: Accuracy of Sphere (to Zero) Component for Eyes with Spherical Myopia (N=83)

	Pre-Op (n=83)	1 Month (n=83)	3 Months (n=82)	6 Months (n=83)	9 Months (n=73)	12 Months (n=46)
	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)
Sphere						
± 0.50 D	0 0.0 (0.0, 3.5)	70 84.3 (74.7, 91.4)	72 87.8 (78.7, 94.0)	71 85.5 (76.1, 92.3)	62 84.9 (74.6, 92.2)	40 87.0 (73.7, 95.1)
± 1.00 D	0 0.0 (0.0, 3.5)	79 95.2 (88.1, 98.7)	81 98.8 (93.4, 100.0)	81 97.6 (91.6 99.7)	71 97.3 (90.5, 99.7)	45 97.8 (88.5, 99.9)
Mean ± SD	-8.21 ± 1.22	0.12 ± 0.50	0.03 ± 0.47	-0.02 ± 0.48	-0.03 ± 0.47	-0.05 ± 0.41
Attempted		-8.21	-8.20	-8.21	-8.27	-8.07
Achieved		-8.33	-8.23	-8.19	-8.23	-8.01
% Achieved		101.5	100.4	99.7	99.7	99.2

Table 11: Accuracy of Sphere (to Zero) and Cylinder (to Zero) Component for Eyes with Myopic Astigmatism (N= 101)

	Pre-Op (n=101)	1 Month (n=101)	3 Months (n=98)	6 Months (n=95)	9 Months (n=97)	12 Months (n=61)
	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)
Sphere						
± 0.50 D	0 0.0 (0.0, 2.9)	74 73.3 (63.5, 81.6)	73 74.5 (64.7, 82.8)	70 73.7 (63.6, 82.2)	78 80.4 (71.1, 87.8)	53 86.9 (75.8, 94.2)
± 1.00 D	0 0.0 (0.0, 2.9)	94 93.1 (86.2, 97.2)	90 91.8 (84.5, 96.4)	89 93.7 (86.8, 97.6)	91 93.8 (87.0, 97.7)	58 95.1 (86.3, 99.0)
Mean ± SD	-7.74 ± 1.42	0.17 ± 0.60	0.11 ± 0.65	0.07 ± 0.63	0.05 ± 0.57	-0.03 ± 0.58
Attempted		-7.74	-7.74	-7.78	-7.76	-8.02
Achieved		-7.92	-7.85	-7.85	-7.81	-7.99
% Achieved		102.6	101.7	101.1	100.9	99.5
Cylinder						
± 0.50 D	0 0.0 (0.0, 2.9)	74 73.3 (63.5, 81.6)	65 66.3 (56.1, 75.6)	62 65.3 (54.8, 74.7)	68 70.1 (60.0, 79.0)	41 67.2 (54.0, 78.7)
± 1.00 D	33 32.7 (23.7, 42.7)	96 95.0 (88.8, 98.4)	94 95.9 (89.9, 98.9)	87 91.6 (84.1, 96.3)	90 92.8 (85.7, 97.0)	59 96.7 (88.7, 99.6)
Mean ± SD	-1.71 ± 0.93	-0.38 ± 0.41	-0.41 ± 0.38	-0.44 ± 0.47	-0.43 ± 0.44	-0.45 ± 0.43
Attempted		-1.71	-1.70	-1.64	-1.68	-1.46
Achieved		-1.33	-1.30	-1.21	-1.25	-1.01
% Achieved		76.4	72.8	70.0	71.8	66.6

Tables 12, 13, and 14 present the accuracy of MRSE over time for all eyes, eyes with spherical myopia, and eyes with myopic astigmatism. At 6 months post-operatively, 95.5% (170/178) of all eyes were within 1.0 D of attempted correction.

Table 12: Accuracy of Manifest Refraction Attempted vs. Achieved for All Eyes (N=184)

	Pre-Op (n=184)	1 Month (n=184)	3 Months (n=180)	6 Months (n=178)	9 Months (n=170)	12 Months (n=107)
	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)
MRSE						
± 0.50 D	0 0.0 (0.0, 1.6)	146 79.3 (72.8, 85.0)	140 77.8 (71.0, 83.6)	137 77.0 (70.1, 82.9)	137 80.6 (73.8, 86.2)	88 82.2 (73.7, 89.0)
± 1.00 D	0 0.0 (0.0, 1.6)	177 96.2 (92.3, 98.5)	171 95.0 (90.7, 97.7)	170 95.5 (91.3, 98.0)	162 95.3 (90.9, 97.9)	102 95.3 (89.4, 98.5)
± 2.00 D	0 0.0 (0.0, 1.6)	184 100.0 (98.4, 100.0)	179 99.4 (96.9, 100.0)	178 100.0 (98.3, 100.0)	170 100.0 (98.3, 100.0)	107 100.0 (97.2, 100.0)
Not Reported	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
Overcorrected						
> 1.00 D		7 3.8 (1.5, 7.7)	6 3.3 (1.2, 7.1)	4 2.2 (0.6, 5.7)	4 2.4 (0.6, 5.9)	1 0.9 (0.0, 5.1)
> 2.00 D		0 0.0 (0.0, 1.6)	1 0.6 (0.0, 3.1)	0 0.0 (0.0, 1.7)	0 0.0 (0.0, 1.7)	0 0.0 (0.0, 2.8)
Undercorrected						
< -1.00		0 0.0 (0.0, 1.6)	3 1.7 (0.3, 4.8)	4 2.2 (0.6, 5.7)	4 2.4 (0.6, 5.9)	4 3.7 (1.0. 9.3)
< -2.00		0 0.0 (0.0, 1.6)	0 0.0 (0.0, 1.7)	0 0.0 (0.0, 1.7)	0 0.0 (0.0, 1.7)	0 0.0 (0.0, 2.8)

Table 13: Accuracy of Manifest Refraction: Attempted vs. Achieved for Eyes with Spherical Myopia (N=83)

	Pre-Op (n=83)	1 Month (n=83)	3 Months (n=82)	6 Months (n=83)	9 Months (n=73)	12 Months (n=46)
	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)
MRSE						
± 0.50 D	0 0.0 (0.0, 3.5)	71 85.5 (76.1 ,92.3)	69 84.1 (74.4, 91.3)	68 81.9 (72.0, 89.5)	62 84.9 (74.6, 92.2)	42 91.3 (79.2, 97.6)
± 1.00 D	0 0.0 (0.0, 3.5)	80 96.4 (89.8, 99.2)	81 98.8 (93.4, 100.0)	82 98.8 (93.5, 100.0)	72 98.6 (92.6, 100.0)	46 100.0 (93.7, 100.0)
± 2.00 D	0 0.0 (0.0, 3.5)	83 100.0 (96.5, 100.0)	81 98.8 (93.4, 100.0)	83 100.0 (96.5, 100.0)	73 100.0 (96.0, 100.0)	46 100.0 (93.7, 100.0)
Not Reported	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
Overcorrected						
> 1.00 D		3 3.6 (0.8, 10.2)	1 1.2 (0.0, 6.6)	1 1.2 (0.0, 6.5)	1 1.4 (0.0, 7.4)	0 0.0 (0.0, 6.3)
> 2.00 D		0 0.0 (0.0, 3.5)	1 1.2 (0.0, 6.6)	0 0.0 (0.0, 3.5)	0 0.0 (0.0, 4.0)	0 0.0 (0.0, 6.3)
Undercorrected						
< -1.00		0 0.0 (0.0, 3.5)	0 0.0 (0.0, 3.6)	0 0.0 (0.0, 3.5)	0 0.0 (0.0, 4.0)	0 0.0 (0.0, 6.3)
< -2.00		0 0.0 (0.0, 3.5)	0 0.0 (0.0, 3.6)	0 0.0 (0.0, 3.5)	0 0.0 (0.0, 4.0)	0 0.0 (0.0, 6.3)

Table 14: Accuracy of Manifest Refraction: Attempted vs. Achieved for Eyes with Myopic Astigmatism (N=101)

	Pre-Op (n=101)	1 Month (n=101)	3 Months (n=98)	6 Months (n=95)	9 Months (n=97)	12 Months (n=61)
	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)	n % (95% CI)
MRSE						
± 0.50 D	0 0.0 (0.0, 2.9)	75 74.3 (64.6, 82.4)	71 72.4 (62.5, 81.0)	69 72.6 (62.5, 81.3)	75 77.3 (67.7, 85.2)	46 75.4 (62.7, 85.5)
± 1.00 D	0 0.0 (0.0, 2.9)	97 96.0 (90.2, 98.9)	90 91.8 (84.5, 96.4)	88 92.6 (85.4, 97.0)	90 92.8 (85.7, 97.0)	56 91.8 (81.9, 97.3)
± 2.00 D	0 0.0 (0.0, 2.9)	101 100 (97.1, 100.0)	98 100 (97.0, 100.0)	95 100 (96.9, 100.0)	97 100.0 (97.0, 100.0)	61 100.0 (95.2, 100.0)
Not Reported	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
Overcorrected						
> 1.00 D		4 4.0 (1.1, 9.8)	5 5.1 (1.7, 11.5)	3 3.2 (0.7, 9.0)	3 3.1 (0.6, 8.8)	1 1.6 (0.0, 8.8)
> 2.00 D		0 0.0 (0.0, 2.9)	0 0.0 (0.0, 3.0)	0 0.0 (0.0, 3.1)	0 0.0 (0.0, 3.0)	0 0.0 (0.0, 4.8)
Undercorrected						
< -1.00		0 0.0 (0.0, 2.9)	3 3.1 (0.6, 8.7)	4 4.2 (1.2, 10.4)	4 4.1 (1.1, 10.2)	4 6.6 (1.8, 15.9)
< -2.00		0 0.0 (0.0, 2.9)	0 0.0 (0.0, 3.0)	0 0.0 (0.0, 3.1)	0 0.0 (0.0, 3.0)	0 0.0 (0.0, 4.8)

3) Summary of Key Safety and Effectiveness Variables

Summaries of the key safety and effectiveness variables at Stability Endpoint of 6 months stratified by pre-operative MRSE are presented in Tables 15, 16, and 17 for all eyes, eyes with spherical myopia, and eyes with myopic astigmatism, respectively.

Table 15: Summary of Key Safety and Effectiveness Variables at Stability Endpoint of 6 Months: All Eyes Stratified by Pre-Operative MRSE (N=178)

CRITERIA	-6.0 to –7.0 n, % (95% CI)	<–7.0 to –8.0 n, % (95% CI)	<–8.0 to –9.0 n, % (95% CI)	<–9.0 to –10.0 n, % (95% CI)	<–10.0 to –11.0 n, % (95% CI)	<–11.0 to –12.0 n, % (95% CI)	Cum Total n, % (95% CI)
	n=21	n=53	n=50	n=29	n=17	n=8	n=178
EFFECTIVENESS VARIABLES†							
UCVA 20/20 or better	16 76.2 (52.8, 91.8)	44 83.0 (70.2, 91.9)	43 86.0 (73.3, 94.2)	24 82.8 (64.2, 94.2)	15 88.2 (63.6, 98.5)	8 100.0 (68.8, 100.0)	150 84.3 (78.1, 89.3)
UCVA 20/40 or better	21 100.0 (86.7, 100.0)	52 98.1 (89.9, 100.0)	48 96.0 (86.3, 99.5)	29 100.0 (90.2, 100.0)	17 100.0 (83.8, 100.0)	8 100.0 (68.8, 100.0)	175 98.3 (95.2, 99.7)
MRSE ± 0.50 D	17 81.0 (58.1, 94.6)	43 81.1 (68.0, 90.6)	38 76.0 (61.8, 86.9)	21 72.4 (52.8, 87.3)	10 58.8 (32.9, 81.6)	8 100.0 (68.8, 100.0)	137 77.0 (70.1, 82.9)
MRSE ± 1.00 D	21 100.0 (86.7, 100.0)	52 98.1 (89.9, 100.0)	47 94.0 (83.5, 98.7)	28 96.6 (82.2, 99.9)	14 82.4 (56.6, 96.2)	8 100.0 (68.8, 100.0)	170 95.5 (91.3, 98.0)
MRSE ± 2.00 D	21 100.0 (86.7, 100.0)	53 100.0 (94.5, 100.0)	50 100.0 (94.2, 100.0)	29 100.0 (90.2, 100.0)	17 100.0 (83.8, 100.0)	8 100.0 (68.8, 100.0)	178 100.0 (98.3, 100.0)
SAFETY VARIABLES							
Loss of ≥ 2 lines BSCVA	0 0.0 (0.0, 13.3)	0 0.0 (0.0, 5.5)	0 0.0 (0.0, 5.8)	0 0.0 (0.0, 9.8)	0 0.0 (0.0, 16.2)	0 0.0 (0.0, 31.2)	0 0.0 (0.0, 1.7)
Loss of > 2 lines BSCVA	0 0.0 (0.0, 13.3)	0 0.0 (0.0, 5.5)	0 0.0 (0.0, 5.8)	0 0.0 (0.0, 9.8)	0 0.0 (0.0, 16.2)	0 0.0 (0.0, 31.2)	0 0.0 (0.0, 1.7)
BSCVA worse than 20/25	0 0.0 (0.0, 13.3)	0 0.0 (0.0, 5.5)	0 0.0 (0.0, 5.8)	0 0.0 (0.0, 9.8)	0 0.0 (0.0, 16.2)	0 0.0 (0.0, 31.2)	0 0.0 (0.0, 1.7)
BSCVA worse than 20/40	0 0.0 (0.0, 13.3)	0 0.0 (0.0, 5.5)	0 0.0 (0.0, 5.8)	0 0.0 (0.0, 9.8)	0 0.0 (0.0, 16.2)	0 0.0 (0.0, 31.2)	0 0.0 (0.0, 1.7)
Increase > 2D cylinder^	0 0.0 (0.0, 13.3)	0 0.0 (0.0, 5.5)	0 0.0 (0.0, 5.8)	0 0.0 (0.0, 9.8)	0 0.0 (0.0, 16.2)	0 0.0 (0.0, 31.2)	0 0.0 (0.0, 1.7)

† Refractions and visual acuities were measured at 4 meters; results shown are adjusted for optical infinity.
^Analysis limited to eyes with spherical myopia (N=83)

Table 16: Summary of Key Safety and Effectiveness Variables at Stability Endpoint of 6 Months: Spherical Myopia Stratified by Pre-Operative MRSE (N=83)

CRITERIA	-6.0 to –7.0 n, % (95% CI)	<–7.0 to –8.0 n, % (95% CI)	<–8.0 to –9.0 n, % (95% CI)	<–9.0 to –10.0 n, % (95% CI)	<–10.0 to –11.0 n, % (95% CI)	<–11.0 to –12.0 n, % (95% CI)	Cum Total n, % (95% CI)
	n=9	n=27	n=26	n=12	n=7	n=2	n=83
EFFECTIVENESS VARIABLES†							
UCVA 20/20 or better	9 100.0 (71.7, 100.0)	26 96.3 (81.0, 99.9)	26 100.0 (89.1, 100.0)	12 100.0 (77.9, 100.0)	7 100.0 (65.2, 100.0)	2 100.0 (22.4, 100.0)	82 98.8 (93.5, 100.0)
UCVA 20/40 or better	9 100.0 (71.7, 100.0)	26 96.3 (81.0, 99.9)	26 100.0 (89.1, 100.0)	12 100.0 (77.9, 100.0)	7 100.0 (65.2, 100.0)	2 100.0 (22.4, 100.0)	82 98.8 (93.5, 100.0)
MRSE ± 0.50 D	9 100.0 (71.7, 100.0)	21 77.8 (57.7, 91.4)	21 80.8 (60.6, 93.4)	10 83.3 (51.6, 97.9)	5 71.4 (29.0, 96.3)	2 100.0 (22.4, 100.0)	68 81.9 (72.0, 89.5)
MRSE ± 1.00 D	9 100.0 (71.7, 100.0)	26 96.3 (81.0, 99.9)	26 100.0 (89.1, 100.0)	12 100.0 (77.9, 100.0)	7 100.0 (65.2, 100.0)	2 100.0 (22.4, 100.0)	82 98.8 (93.5, 100.0)
MRSE ± 2.00 D	9 100.0 (71.7, 100.0)	27 100.0 (89.5, 100.0)	26 100.0 (89.1, 100.0)	12 100.0 (77.9, 100.0)	7 100.0 (65.2, 100.0)	2 100.0 (22.4, 100.0)	83 100.0 (96.5, 100.0)
SAFETY VARIABLES							
Loss of ≥ 2 lines BSCVA	0 0.0 (0.0, 28.3)	0 0.0 (0.0, 10.5)	0 0.0 (0.0, 10.9)	0 0.0 (0.0, 22.1)	0 0.0 (0.0, 34.8)	0 0.0 (0.0, 77.6)	0 0.0 (0.0, 3.5)
Loss of > 2 lines BSCVA	0 0.0 (0.0, 28.3)	0 0.0 (0.0, 10.5)	0 0.0 (0.0, 10.9)	0 0.0 (0.0, 22.1)	0 0.0 (0.0, 34.8)	0 0.0 (0.0, 77.6)	0 0.0 (0.0, 3.5)
BSCVA worse than 20/25	0 0.0 (0.0, 28.3)	0 0.0 (0.0, 10.5)	0 0.0 (0.0, 10.9)	0 0.0 (0.0, 22.1)	0 0.0 (0.0, 34.8)	0 0.0 (0.0, 77.6)	0 0.0 (0.0, 3.5)
BSCVA worse than 20/40	0 0.0 (0.0, 28.3)	0 0.0 (0.0, 10.5)	0 0.0 (0.0, 10.9)	0 0.0 (0.0, 22.1)	0 0.0 (0.0, 34.8)	0 0.0 (0.0, 77.6)	0 0.0 (0.0, 3.5)
Increase > 2D cylinder	0 0.0 (0.0, 28.3)	0 0.0 (0.0, 10.5)	0 0.0 (0.0, 10.9)	0 0.0 (0.0, 22.1)	0 0.0 (0.0, 34.8)	0 0.0 (0.0, 77.6)	0 0.0 (0.0, 3.5)

†Refractions and visual acuities were measured at 4 meters; results shown are adjusted for optical infinity.

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Table 17: Summary of Key Safety and Effectiveness Variables at Stability Endpoint of 6 Months: Myopic Astigmatism Stratified by Pre-Operative MRSE (N=95)

CRITERIA	-6.0 to –7.0 n, % (95% CI)	<–7.0 to –8.0 n, % (95% CI)	<–8.0 to –9.0 n, % (95% CI)	<–9.0 to –10.0 n, % (95% CI)	<–10.0 to –11.0 n, % (95% CI)	<–11.0 to –12.0 n, % (95% CI)	Cum Total n, % (95% CI)
	n=12	n=26	n=24	n=17	n=10	n=6	n=95
EFFECTIVENESS VARIABLES†							
UCVA 20/20 or better	7 58.3 (27.7, 84.8)	18 69.2 (48.2, 85.7)	17 70.8 (48.9, 87.4)	12 70.6 (44.0, 89.7)	8 80.0 (44.4, 97.5)	6 100 (60.7, 100)	68 71.6 (61.4, 80.4)
UCVA 20/40 or better	12 100 (77.9, 100)	26 100 (89.1, 100)	22 91.7 (73.0, 99.0)	17 100 (83.8, 100)	10 100 (74.1, 100)	6 100 (60.7, 100)	93 97.9 (92.6, 99.7)
MRSE ± 0.50 D	8 66.7 (34.9, 90.1)	22 84.6 (65.1, 95.6)	17 70.8 (48.9, 87.4)	11 64.7 (38.3, 85.8)	5 50.0 (18.7, 81.3)	6 100 (60.7, 100)	69 72.6 (62.5, 81.3)
MRSE ± 1.00 D	12 100 (77.9, 100)	26 100 (89.1, 100)	21 87.5 (67.6, 97.3)	16 94.1 (71.3, 99.9)	7 70.0 (34.8, 93.3)	6 100 (60.7, 100)	88 92.6 (85.4, 97.0)
MRSE ± 2.00 D	12 100 (77.9, 100)	26 100 (89.1, 100)	24 100 (88.3, 100)	17 100 (83.8, 100)	10 100 (74.1, 100)	6 100 (60.7, 100)	95 100 (96.9, 100)
SAFETY VARIABLES							
Loss of ≥ 2 lines BSCVA	0 0.0 (0.0, 22.1)	0 0.0 (0.0, 10.9)	0 0.0 (0.0, 11.7)	0 0.0 (0.0, 16.2)	0 0.0 (0.0, 25.9)	0 0.0 (0.0, 39.3)	0 0.0 (0.0, 3.1)
Loss of > 2 lines BSCVA	0 0.0 (0.0, 22.1)	0 0.0 (0.0, 10.9)	0 0.0 (0.0, 11.7)	0 0.0 (0.0, 16.2)	0 0.0 (0.0, 25.9)	0 0.0 (0.0, 39.3)	0 0.0 (0.0, 3.1)
BSCVA worse than 20/25	0 0.0 (0.0, 22.1)	0 0.0 (0.0, 10.9)	0 0.0 (0.0, 11.7)	0 0.0 (0.0, 16.2)	0 0.0 (0.0, 25.9)	0 0.0 (0.0, 39.3)	0 0.0 (0.0, 3.1)
BSCVA worse than 20/40	0 0.0 (0.0, 22.1)	0 0.0 (0.0, 10.9)	0 0.0 (0.0, 11.7)	0 0.0 (0.0, 16.2)	0 0.0 (0.0, 25.9)	0 0.0 (0.0, 39.3)	0 0.0 (0.0, 3.1)

† Refractions and visual acuities were measured at 4 meters; results shown are adjusted for optical infinity.

d. Higher Order Aberrations

Although the WaveScan WaveFront® System measures the refractive error and wavefront aberrations of the human eyes, including myopia, hyperopia, astigmatism, coma, spherical aberration, trefoil, and other higher order aberrations through sixth order, in the clinical study for this PMA, the average higher order aberration increased after CustomVue™ treatment. The most noticeable increases were in coma and spherical aberration. The clinical data over 9 months showed that the changes in all higher order aberrations were stable postoperatively.

Table 18 presents wavefront root-mean-square (RMS) values over time.

Table 18: RMS Over Time: All Eyes (N=184^)

	Pre-Op Mean ± SD	1 Month Mean ± SD	3 Months Mean ± SD	6 Months Mean ± SD	9 Months Mean ± SD	12 Months Mean ± SD
	n=184	n=174	n=174	n=169	n=162	n=101
All higher order	0.17 ± 0.06	0.32 ± 0.10	0.33 ± 0.10	0.33 ± 0.10	0.34 ± 0.10	0.35 ± 0.10
Coma	0.10 ± 0.06	0.24 ± 0.12	0.26 ± 0.12	0.26 ± 0.12	0.27 ± 0.12	0.28 ± 0.12
Trefoil	0.08 ± 0.05	0.10 ± 0.05	0.09 ± 0.05	0.09 ± 0.06	0.10 ± 0.05	0.09 ± 0.05
Spherical Aberration	0.06 ± 0.04	0.11 ± 0.07	0.10 ± 0.07	0.11 ± 0.08	0.11 ± 0.07	0.11 ± 0.08
Secondary Astigmatism	0.03 ± 0.02	0.05 ± 0.03	0.06 ± 0.03	0.06 ± 0.03	0.06 ± 0.03	0.05 ± 0.03
Tetrafoil	0.03 ± 0.02	0.05 ± 0.03	0.05 ± 0.03	0.05 ± 0.03	0.05 ± 0.03	0.06 ± 0.04
5th order	0.02 ± 0.02	0.05 ± 0.03	0.04 ± 0.02	0.04 ± 0.02	0.04 ± 0.02	0.04 ± 0.03
6th order	0.02 ± 0.01	0.04 ± 0.02	0.04 ± 0.02	0.03 ± 0.02	0.03 ± 0.02	0.03 ± 0.03
Signed Value of Spherical Aberration	0.04 ± 0.06	0.07 ± 0.11	0.09 ± 0.09	0.10 ± 0.09	0.10 ± 0.09	0.10 ± 0.09
Min, Max	(-0.13, 0.18)	(-0.22, 0.29)	(-0.14, 0.29)	(-0.11, 0.31)	(-0.18, 0.38)	(-0.14, 0.31)
	n=184	n=181	n=177	n=175	n=164	n=102
WaveScan SE†	-8.24 ± 1.40	0.22 ± 0.78	0.16 ± 0.68	0.00 ± 0.70	-0.02 ± 0.70	-0.16 ± 0.57
Astigmatism Magnitude†	1.24 ± 1.00	0.59 ± 0.51	0.56 ± 0.36	0.56 ± 0.32	0.59 ± 0.31	0.53 ± 0.29

^Wavefront aberrations are calculated over a 5 mm area. Eyes with wavefront measurements of ≥ 5 mm are included in this analysis.
† WaveScan spherical equivalent and astigmatism analyses are calculated over a 4 mm area. Eyes with wavefront measurements of ≥ 4 mm are included in this analysis.

e. Safety Outcomes[1]

Data from the clinical study provided reasonable assurance of device safety. The benchmark for each adverse event is a rate of less than 1 % per type of event. No eyes experienced any of the adverse events defined in the October 10, 1996 FDA Guidance Document for Refractive Surgery Lasers, as presented in Table 19. However, four adverse events were reported. Two eyes of two separate subjects developed trace diffuse lamellar keratitis (DLK) prior to the 1-month visit, one eye of one subject experienced a metallic foreign body with subsequent rust ring that occurred at an interim one month visit and resolved by the 3 month visit exam, and at the 9-month visit, one subject reported having undergone excision of a benign parotid gland tumor.

Complications that occurred during the clinical trial are summarized in Table 20. Analyses of contrast sensitivity outcomes are presented in Tables 21 and 22.

Table 19: Summary of Adverse Events (N=184)

	<1 Month (n=184)		1 Month (n=184)		3 Months (n=180)		6 Months (n=178)		9 Months (n=170)		12 Months (n=107)	
	n	%	n	%	n	%	n	%	n	%	n	%
Corneal Infiltrate/Ulcer	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Corneal epithelial defect involving the keratectomy at 1 month or later	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Corneal edema at 1 month or later (specify "flap" or "bed" or both)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Epithelium in the interface with loss of 2 or more lines of BSCVA	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Miscreated Flap	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Melting of the flap (LASIK only)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Uncontrolled IOP >10 mm Hg or any reading > 25 mm Hg	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Late onset of haze beyond 6 months with loss of 2 lines (10 letters) or more BSCVA	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Decrease in BSCVA of > 10 letter not due to irregular astigmatism as shown by hard contact lens refraction, at 6 months or later	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Retinal Detachment	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Retinal Vascular Accidents	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

[1] Adverse Events and Complications outlined in the October 10, 1996 FDA Guidance Document for Refractive Surgery Lasers are included in Tables 19 and 20. Adverse Events are serious (sight or life-threatening) and unanticipated events; complications are anticipated, transient, and non-sight threatening sequelae to the surgery.

Table 20: Summary of Complications (N=184)												
	<1 Month (n=184)		1 Month (n=184)		3 Months (n=180)		6 Months (n=178)		9 Months (n=170)		12 Months (n=107)	
	n	%	n	%	n	%	n	%	n	%	n	%
Misaligned flap	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Corneal edema between 1 week and 1 month after the procedure	5	2.7	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0
Peripheral corneal epithelial defect at 1 month or later	4	2.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Epithelium in the interface[2]	1	0.5	2	1.1	0	0.0	0	0.0	0	0.0	0	0.0
Foreign body sensation at 1 month or later	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0
Pain at 1 month or later	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Diplopia (ghost images) in the operative eye[3]	0	0.0	11	6.0	9	5.0	6	3.4	5	2.9	4	3.7

[2] Overall, 3 eyes (3/184, 1.6%) experienced epithelium in the interface.
[3] Overall, 16 eyes (16/184, 8.7%) experienced diplopia.

Table 21 presents the results of the contrast sensitivity analysis pre-operatively and at 1, 3, 6 and 12-months post-operatively. A positive mean change reflects an improvement in contrast sensitivity.

Table 21: Contrast Sensitivity for All Eyes (N=184)

	Pre-Op (n=184)				Change from Pre-Op to 1 Month (n=178)				Change from Pre-Op to 3 Months (n=178)			
CPD	3	6	12	18	3	6	12	18	3	6	12	18
Dim w/ Glare												
Mean	1.52	1.52	1.00	0.54	-0.01	-0.05	-0.08	-0.01	0.00	-0.02	-0.07	0.00
(SE)	0.017	0.023	0.030	0.032	0.018	0.028	0.033	0.033	0.019	0.029	0.037	0.040
P Value*					0.622	0.065	0.023	0.789	0.923	0.441	0.084	0.973
Dim w/o Glare												
Mean	1.59	1.63	1.12	0.65	0.00	-0.03	-0.08	-0.03	-0.02	-0.06	-0.08	-0.04
(SE)	0.020	0.023	0.033	0.035	0.018	0.024	0.033	0.036	0.020	0.028	0.037	0.040
P Value* ≤					0.972	0.165	0.012	0.471	0.362	0.033	0.038	0.338
Bright w/o Glare												
Mean	1.76	1.95	1.61	1.14	-0.02	-0.06	-0.09	-0.05	-0.04	-0.06	-0.10	-0.08
(SE)	0.013	0.014	0.019	0.019	0.015	0.019	0.029	0.026	0.015	0.023	0.029	0.027
P Value* ≤					0.256	0.001	0.004	0.041	0.016	0.005	0.001	0.003

*Two tailed paired t test for the means.

Table 21 (continued): Contrast Sensitivity for All Eyes (N=184)

	Change from Pre-Op to 6 Months (n=178)				Change from Pre-Op to 12 Months (n=107)			
CPD	3	6	12	18	3	6	12	18
Dim w/ Glare								
Mean	0.01	0.01	0.04	0.06	0.01	0.05	0.12	0.14
(SE)	0.020	0.026	0.035	0.037	0.026	0.036	0.041	0.04
P Value*	0.497	0.610	0.263	0.131	0.720	0.155	0.004	0.001
Dim w/o Glare								
Mean	-0.01	0.02	0.02	0.05	-0.01	0.02	0.08	0.08
(SE)	0.018	0.023	0.033	0.034	0.028	0.035	0.044	0.048
P Value* ≤	0.716	0.390	0.602	0.111	0.696	0.604	0.085	0.091
Bright w/o Glare								
Mean	-0.02	-0.01	-0.02	0.00	-0.03	-0.06	-0.06	-0.01
(SE)	0.017	0.017	0.024	0.023	0.023	0.025	0.036	0.032
P Value* ≤	0.255	0.480	0.448	0.894	0.230	0.018	0.110	0.830

*Two tailed paired t test for the means.

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Table 22 presents the number and percent of eyes with changes from baseline (>0.30 log units at 2 or more spatial frequencies) in contrast sensitivity at 3, 6 and 12-months post-operatively.

Table 22: Change in Contrast Sensitivity for All Eyes (N=184)

	3 Months (n=178)			6 Months (n=178)			12 Months (n=107)		
	Decrease n %	No Change n %	Increase n %	Decrease n %	No Change n %	Increase n %	Decrease n %	No Change n %	Increase n %
Bright without Glare	25 14.0%	146 82.0%	7 3.9%	19 10.7%	143 80.3%	16 9.0%	15 14.0%	83 77.6%	9 8.4%
Dim without Glare	37 20.8%	112 62.9%	29 16.3%	28 15.7%	111 62.4%	39 21.9%	17 15.9%	62 57.9%	28 26.2%
Dim with Glare	34 19.1%	114 64.0%	30 16.9%	40 22.5%	90 50.6%	48 27.0%	14 13.1%	64 59.8%	29 27.1%

f. Retreatment

As of the database lock on May 2, 2005, four (4) eyes of three subjects had undergone retreatment. Two eyes were retreated after the 9 month exam and 2 eyes were retreated after the 12 month exam. Data from these eyes, prior to retreatment, are included in all analyses. Four retreatments are insufficient to yield clinically useful information; however, caution should be taken to assure refractive stability before performing additional procedures.

g. Factors Associated with Outcomes

To evaluate the consistency of results and effect of treatment by study site and baseline characteristics, results at the 6 month point of stability were analyzed. The observed outcomes for key safety and effectiveness variables were calculated and compared to target percentages to determine if the results were significantly different. For each effectiveness criterion, comparisons were made using a chi-square goodness-of-fit test. A Mantel-Haenszel one degree of freedom chi-square test was used to compare the observed percentages across categories. Those p-values are used to identify situations where there are significant differences between categories.

Specifically, the analyses of effect included: sex (Female and Male), race (White and Other), investigational site (1, 2, 3, 4, 5, 6, and 9), age group (<30, 30 to 39, 40 to 49, and ≥50), pre-operative contact lens use (None, Soft, and GP/PMMA), pre-operative MRSE (<- 6.00 to –7.00, <-7.00 to –8.00, <-8.00 to –9.00, <-9.00 to -10.00, <-10.00 to –11.00, <-11.00 to –12.00), laser room temperature (< 70°, 70°, 71°, 72° to 73°,

74°, and ≥ 75°), laser room humidity (< 30%, 30% to 35%, 36% to 40%, 41% to 45%, and > 45%), surgeon, and microkeratome model.

In these analyses, statistically significant differences in outcomes were identified by comparing actual outcomes with target values (MRSE ± 0.50 / 50% and 30%, MRSE ± 1.00 / 75% and 60%, MRSE ± 2.00 / 90%, UCVA 20/40 or better / 85% and 75%, BSCVA worse than 20/40, < 1%, and loss of >2 lines BSCVA, < 5%).

Throughout all of these analyses, there were no cases where the observed value does not meet the target value. All subcategories met the target value.

No eye had a BSCVA loss of > 2 lines and no eye had a BSCVA worse than 20/40, so there were no detectable differences between study sites and baseline characteristics relative to safety outcomes.

Of the factors evaluated for impact on outcomes, contact lens, relative humidity, pre-study MRSE, race, surgeon, and temperature demonstrated no statistically significant differences between subcategories for all outcomes. Statistically significant differences in outcome were found for age, site, sex, and microkeratome model.

The 40 to 49 age group had significantly lower percentages of MRSE ± 0.50 D (p=0.0062) and MRSE ± 1.00 D compared to other groups (p=0.0041). Despite these differences, eyes in this age category exceeded the target percentages for MRSE ± 0.50 D and ± 1.00 D.

There was a significant difference among sites for MRSE ± 0.50 D (p=0.0412). Sixty-five percent of subjects at site 2 and 62% of subjects at site 6 had MRSE ± 0.50 D while 94% of subjects at site 1 and 90% of subjects at site 4 had MRSE ± 0.50 D. Even though this difference exists, the observed percentage of subjects with MRSE ± 0.50 D at site 2 and 6 exceeded the target percentages for MRSE ± 0.50 D.

Male subjects had a significantly higher proportion of MRSE ± 1.00 D than female subjects (100% versus 91%, p=0.0064). Despite this difference, the percentages of males and females with MRSE ± 1.00 D exceeded the target percentages for MRSE ± 1.00 D.

One microkeratome model had a significantly lower percentage (86%, p=0.0221) of MRSE ± 1.00 D compared to other microkeratome models (97% and 100%). Despite this difference, eyes treated with all microkeratome models exceeded the target percentages for MRSE ± 1.00 D.

Based on an exploratory multifactor ANOVA analysis of MRSE, which included all main effects and two-factor interactions of Site, Age, Sex, and Keratome model, no clinically significant relationship of Site, Age, Sex, and microkeratome model to MRSE outcomes were apparent.

h. Patient Satisfaction

Patients were asked to complete a questionnaire for each eye to evaluate vision pre-operatively and post-operatively. Upon completion of the questionnaire, both the patient and the investigator reviewed the form. To be included in the analysis, a pre-operative questionnaire had to have been completed. Patient questionnaire responses are presented pre-operatively and at 3 and 6 months post-operatively. Tables 23 and 24 present a summary of patient satisfaction and patient symptoms.

Table 23: Summary of Patient Satisfaction for All Eyes (N=182*)

	Very Satisfied			Satisfied			Not Sure			Somewhat Dissatisfied			Very Dissatisfied			Not Reported		
	Pre n=182	3M n=178	6M n=176	Pre n=182	3M n=178	6M n=176	Pre n=182	3M n=178	6M n=176	Pre n=182	3M n=178	6M n=176	Pre n=182	3M n=178	6M n=176	Pre n=182	3M n=178	6M n=176
	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %
Sharpness and Clarity	38	116	107	107	43	47	9	6	6	22	12	16	6	0	0	0	1	0
	20.9	65.5	60.8	58.8	24.3	26.7	4.9	3.4	3.4	12.1	6.8	9.1	3.3	0.0	0.0	0.0	0.6	0.0
Consistency of Vision	39	99	108	103	60	55	6	6	5	30	13	8	4	0	0	0	0	0
	21.4	55.6	61.4	56.6	33.7	31.3	3.3	3.4	2.8	16.5	7.3	4.5	2.2	0.0	0.0	0.0	0.0	0.0
Daylight Vision	42	126	119	117	42	43	4	2	5	18	8	9	1	0	0	0	0	0
	23.1	70.8	67.6	64.3	23.6	24.4	2.2	1.1	2.8	9.9	4.5	5.1	0.5	0.0	0.0	0.0	0.0	0.0
Night Vision	23	56	69	92	87	73	14	15	12	41	19	21	12	1	1	0	0	0
	12.6	31.5	39.2	50.5	48.9	41.5	7.7	8.4	6.8	22.5	10.7	11.9	6.6	0.6	0.6	0.0	0.0	0.0
Night Vision with Glare	18	43	47	77	82	73	21	19	23	42	32	28	24	2	5	0	0	0
	9.9	24.2	26.7	42.3	46.1	41.5	11.5	10.7	13.1	23.1	18.0	15.9	13.2	1.1	2.8	0.0	0.0	0.0

*eyes with preoperative questionnaire.

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Table 24: Summary of Patient Symptoms for All Eyes (N=182*)

	Never			Rarely			Sometimes			Often			Always			Not Reported		
	Pre n=182	3M n=178	6M n=176	Pre n=182	3M n=178	6M n=176	Pre n=182	3M n=178	6M n=176	Pre n=182	3M n=178	6M n=176	Pre n=182	3M n=178	6M n=176	Pre n=182	3M n=178	6M n=176
	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %
Dryness	27	14	14	73	59	90	65	77	53	15	26	17	2	2	2	0	0	0
	14.8	7.9	8.0	40.1	33.1	51.1	35.7	43.3	30.1	8.2	14.6	9.7	1.1	1.1	1.1	0.0	0.0	0.0
Blurry Vision	46	48	54	68	71	80	54	47	32	10	7	5	4	5	5	0	0	0
	25.3	27.0	30.7	37.4	39.9	45.5	29.7	26.4	18.2	5.5	3.9	2.8	2.2	2.8	2.8	0.0	0.0	0.0
Fluctuation of vision	74	69	62	59	53	78	42	43	32	7	11	2	0	2	2	0	0	0
	40.7	38.8	35.2	32.4	29.8	44.3	23.1	24.2	18.2	3.8	6.2	1.1	0.0	1.1	1.1	0.0	0.0	0.0
Glare	42	42	46	64	64	72	56	53	46	20	13	9	0	6	3	0	0	0
	23.1	23.6	26.1	35.2	36.0	40.9	30.8	29.8	26.1	11.0	7.3	5.1	0.0	3.4	1.7	0.0	0.0	0.0
Halos Around Lights	48	33	39	66	53	59	40	60	40	24	20	23	4	12	15	0	0	0
	26.4	18.5	22.2	36.3	29.8	33.5	22.0	33.7	22.7	13.2	11.2	13.1	2.2	6.7	8.5	0.0	0.0	0.0
Difficulty at Night W/Glare	30	29	33	63	71	77	51	48	42	28	19	12	10	11	12	0	0	0
	16.5	16.3	18.8	34.6	39.9	43.8	28.0	27.0	23.9	15.4	10.7	6.8	5.5	6.2	6.8	0.0	0.0	0.0
Ghosting or Shadowing of Images	113	103	116	52	47	39	15	21	16	0	6	3	2	1	2	0	0	0
	62.1	57.9	65.9	28.6	26.4	22.2	8.2	11.8	9.1	0.0	3.4	1.7	1.1	0.6	1.1	0.0	0.0	0.0
Double Images	149	153	158	31	15	13	2	10	5	0	0	0	0	0	0	0	0	0
	81.9	86.0	89.8	17.0	8.4	7.4	1.1	5.6	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

*eyes with preoperative questionnaire.

i. Device Failure

There were no device failures reported during this study.

XI. CONCLUSIONS DRAWN FROM THE STUDIES

Preclinical studies completed for this device did not raise any new safety or effectiveness concerns. Data from the clinical study provided reasonable assurance of device safety and effectiveness, when used in accordance with the directions for use, for wavefront-guided LASIK treatment with the VISX STAR S4 IR™ Excimer Laser System with Variable Spot Scanning and WaveScan® derived ablation targets for the correction of high myopia and myopic astigmatism.

XII. PANEL RECOMMENDATION

In accordance with the provisions of section 515(c)(2) of the act as amended by the Safe Medical Devices Act of 1990, this PMA was not referred to the Ophthalmic Devices Panel, an FDA advisory committee, for review and recommendation because the information in the PMA substantially duplicates information previously reviewed by this panel.

XIII. CDRH DECISION

CDRH issued an approval order on AUG 30 2005

The applicant's manufacturing facility was inspected and found to be in compliance with the Quality System Regulation (21 CFR 820).

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.