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IMPACT OF IRIS REGISTRATION IN ACHIEVING EMMETROPIA ON RESULTS OF FEMTOLASEK FOR MYOPIC ASTIGMATISM WITH THE VISX CUSTOMVUE PLATFORM

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Abstract
Laser refractive surgery, such as in situ keratomileusis (LASIK), has been shown to be affected by factors including eye movement and poor fixation, and cyclotorsional misalignment between the ablation beam and the eye has been linked to postoperative symptoms due to residual under correction. Refractive defects may be corrected via laser in situ keratomileusis (LASIK). Astigmatism, an irregularity in the curvature of the eye that produces impaired distant and near vision, is rather common and can usually be corrected. Uncorrected visual acuity (UCVA), best spectacle-corrected visual acuity (BSCVA), and evident refraction were the primary outcome measurements. Data from patients with myopia who had primary LASIK using the VISX STAR S4 CustomVue laser with or without Iris Registration technology was analyzed. There was a total of 130 eyes from 65 individuals that were myopic or myopic with astigmatism. Results from our research indicate that wavefront-guided LASIK using the VISX CustomVue technology is successful, safe, and predictable, regardless of iris registration status. In our research, we found that FEMTOLASIK, both with and without iris registration, was equally successful in treating myopia with and without astigmatism.

Keywords: IRIS Registration, Emmetropia, Femtolasek, Myopic, Astigmatism

INTRODUCTION

Refractive defects may be corrected via laser in situ keratomileusis (LASIK). In LASIK, a corneal flap is created using a microkeratome or femtosecond laser, and then the cornea is reshaped by excimer laser removal of tissue from the stromal bed underneath the cornea. Myopia of all degrees, with or without astigmatism, may be corrected by LASIK. Dioptric restrictions vary from nation to country and from laser system to laser system. You may check the FDA-approved uses on the product's label in the United States. Certain individuals may be at a higher risk of post-LASIK ectasia and reduced quality of vision if they have surgery to correct their severe myopia. After a thorough preoperative assessment, in which the patient and surgeon discuss the patient's objectives and other options such glasses, contacts, and phakic intraocular lens implantation, the surgeon and patient will then determine whether LASIK is an appropriate treatment. Astigmatism, an irregularity in the curvature of the eye that produces impaired distant and near vision, is rather common and can usually be corrected. An irregular curvature of the cornea (the front surface of the eye) or the crystalline lens (located deep inside the eye) causes astigmatism. The surface doesn't have a single curvature like a baseball, but rather takes on an egg form. Seeing things clearly at any distance is impaired as a result. Many people are born with astigmatism, and it often occurs with myopia or hyperopia. A lot of the time, it's not severe enough to warrant any kind of action. When this occurs, corrective glasses or surgery may help.

LITERATURE REVIEW

Kruh, et al (2016) Determining Factors Associated with Recurrence After Laser In Situ Keratomileusis (LASIK). Substances and techniques: From December 2008 to September 2012, 1,402 patients with myopia were treated with LASIK using the IntralaseTM FS, STAR S4 IRTM Excimer Laser, and WaveScan WaveFrontTM technology, according to a retrospective chart review. Eighty-three people were readmitted to this group. Age, gender, initial manifest refraction spherical equivalent (MRSE), total astigmatism, and iris registration were analyzed for all patients. Preoperative age >40 years ($p<0.001$), initial MRSE > -3.0 D ($p = 0.02$), and astigmatism >1 D ($p = 0.001$) were also associated with increased rates of retreatment after LASIK. Nevertheless, capturing an individual's iris pattern did not result in a statistically significant decrease in the retreatment rate ($p = 0.12$). Preoperative age >40, initial MRSE > -3.0 D, and astigmatism >1D were all associated with a higher likelihood of retreatment. Patients of either sex had the same incidence of retreatment after iris registration capture.

Kanellopoulos, Anastasios (2020) Customization of excimer ablation for myopic LASIK using a unique automated ray tracing optimization method: safety and effectiveness. Twenty-five patients (fifty eyes) who had femtosecond laser-assisted myopic LASIK were studied in a case series. At first, the unique AI platform uses interferometry axial length data to determine a model eye to use in calculating the ablation profile. Raytracing using wavefront and Scheimpflug tomography data allows for the estimation of both low- and high-order aberrations using a single diagnostic tool. Six months after surgery, patients had their vision, refractive error, keratometry, topography, high-order aberrations, and contrast sensitivity checked again. Variation from Before Surgery to Six Months After: Astigmatism decreased from -1.65 ±0.85 diopters (D) to -0.26 ±0.11 D (range: -8.0 to -0.50 D) and refractive error decreased from -5.06 ±2.54 D (range: -8.0 to -0.50 D) to -0.11 ±0.09 D (range: -0.25 to +0.25 D) (range -0.60 to 0). Sixty-five percent of eyes improved by one line and 38 percent by two. The average degree of high-order aberration, as measured by RMSh, increased from 0.25 um preoperatively to 0.35 um postoperatively. After surgery, the patient's ability to perceive contrast increased. In conclusion, using several independent up-to-now diagnostics and a customized eye model reference for each instance, we report safe and successful early findings from excimer laser customisation by ray tracing optimization for myopic LASIK procedures. Improved and more reliable visual results may be possible thanks to its potential advantage in entire eye aberration data and ray tracing refraction computation.

Lan, et al (2021) While refractive surgery has been shown to be a successful means of treating myopia, it has been linked to side effects like glare in the evenings after surgery. We provide an eye modeling approach to evaluating post-femto-LASIK optical quality in light of structural alterations to the eye. Using the pre- and post-op measurements of 134 right eyes, precise models of the eyes were built. Spot diagrams, PSFs, MTFs, and chromatic aberrations were used to measure optical performance at varied fields (0°-30°), pupil sizes (2-6 mm), and starting myopias (1.25 to 10.5 D). Both the size of the pupil and the degree of myopia at the outset are significant variables in how well a patient sees after corrective surgery. Spot diagrams, pupil size functions, and minimum focusing distances all showed that visual performance declined after surgery as visual field and pupil size rose, and that starting myopia played a major role in this. Even after corrective surgery, preexisting myopia had an impact on postoperative chromatic aberrations. The transverse chromatic aberrations were unaffected by the increase in pupil size, but the longitudinal chromatic aberrations decreased marginally after surgery. The use of eye modeling to the evaluation of refractive surgery has the potential to provide a more individualized surgical strategy, to enhance the precision with which surgical results are predicted, and to encourage the development of novel surgical techniques.

Sarkar, Samrat & Vaddavalli, Pravin & Bharadwaj, Shrikant (2016) Higher-order wavefront aberrations (HOAs) in the eye are exacerbated by laser refractive surgery for myopia. Unfortunately, there is little data on how this optical deterioration affects these eyes' image quality (IQ) after surgery. Data from 45 subjects (18–31 years old) before and 1 month after refractive surgery, as well as 40 age-matched emmetropic controls, were used to determine the correlation between HOAs and IQ parameters (peak IQ, dioptric focus that maximizes IQ, and depth of focus) derived from psychophysical (logMAR acuity) and computational (logVSOTF) through-focus curves. The RMS deviation of all HOA's (HORMS) was adversely connected with computationally determined peak IQ and its best focus ($r \geq -0.5$; $p<0.001$ for all). There was a positive correlation between computational depth of focus and HORMS ($r \geq 0.55$; $p<0.001$ for all) and a negative correlation between computational depth of focus and peak IQ ($r \geq -0.8$; $p<0.001$ for all). HORMS showed a weak relationship with all IQ metrics linked to logMAR acuity ($r \leq |0.16|$; $p>0.16$ for all). An increase in HOAs after refractive surgery is consequently linked to a decrease in peak IQ and the maintenance of this sub-standard IQ throughout a greater dioptric range, compared to both pre-surgery and age-matched controls.

Tay, Eugene & Li, Xiang & Gimbel, Howard & Kaye, Geoffrey (2013) IOLMaster LASIK Axial Length Change Assessment Using Theoretical Ablation Depth (Carl Zeiss Meditec, Dublin, CA). Ninety-nine eyes were tested before LASIK, then again at 1- and 3-months following surgery. Before LASIK, the average spherical equivalent was -4.06±1.91 diopters, with a wide range (D). The average depth of

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ablation was 83.13 ±30.31 m (mean SD). After 1month, postoperative axial length was considerably less than preoperative axial length (P.001), at 25.11± 0.14 mm, with no further change afterward (P =.450). An increase of 1 µm in ablation depth resulted in a 0.00118± 0.00005 mm reduction in axial length. There was a moderately good correlation between ablation depth and axial length change (adjusted R(2) = 0.9039). Axial shortening following LASIK, as measured by the IOLMaster, corresponded well with predicted ablation depth.

RESEARCH METHODOLOGY

Methods

Data from patients with myopia who had primary LASIK using the VISX STAR S4 CustomVue laser with or without Iris Registration technology was analyzed. Clinically severe lens opacities, prior corneal or intraocular surgery, corneas thinner than 500 m, keratoconus, unstable refraction, autoimmune illness, pregnancy, breastfeeding, or immunosuppressive medication were all reasons for exclusion from this research. Patients with soft contact lenses were instructed to stop using them two weeks ahead to screening, whereas those with hard gas permeable lenses were given a full six weeks' notice. major corneal or intraocular surgery, unstable refraction, keratoconus, clinically significant lens opacity, systemic or ocular diseases, glaucoma, or corneal irregularity (increase in curvature greater than 47 D with inferior-superior asymmetry lower than 1.5 D, apex displacement greater than 1.5 D, and inferior-superior asymmetry greater than or equal to 1.5 D).

Patients

There was a total of 130 eyes from 65 individuals that were myopic or myopic with astigmatism. Each patient had FEMTOLASIK conducted on one eye using iris recognition software and on the other eye using standard FEMTOLASIK techniques. Uncorrected and corrected distance visual acuity (UDVA and CDVA), cycloplegic refraction, applanation tonometry, anterior and posterior segment biomicroscopy, tonometry, slit-lamp examination of the anterior segment, dilated fundus examination, and aberrometer testing were all performed on all Participants (Zywave II, Technolas Perfect Vision, Munich, Germany).

SPSS was used to do the statistical analysis on the data (version 21 SPSS). The data was analyzed using the Wilcoxon signed rank test, the independent sample test, and the paired Student's test. A probability level of 0.05 was taken as indicative of statistical significance across the board.

DATA ANALYSIS

There were 29 males and 30 women, and their average age was 28.35 (range 18–50 years). The demographic and ocular features of the two groups before to surgery were comparable (Table 1).

Table 1: Comparison of preoperative characteristics

Parameter	Iris registration eyes	Non-iris registration eyes	P value
CDVA			

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Mean logMAR	0.047 ± 0.05	0.043 ± 0.053	0.77
Snellen equivalent	0.89 ± 0.12	0.9 ± 0.11	0.58
Sphere (D)	−2.5 ± 2.1 D (−7.5 to −0.25 D)	−2.5 ± 2.00 D (−7.75 to −0.25 D)	0.91
Cylinder (D)	−3.18 ± 1.5 D (−0.5 to −8.00 D)	−2.9 ± 1.4 D (−0.5 to −6.75 D)	0.43
Sphere equivalent	−4.1 ± 2.00 D (−9.00 to 0.88 D)	−4.03 ± 1.9 D (−0.75 to −8.25 D)	0.86
Pachymetry (mm)	535 ± 37.8 (502–653)	535 ± 40.4 (510–655)	1.000
5-mm pupil			
Higher-order RMS	0.26 ± 0.09	0.26 ± 0.11	0.5
Higher-order RMS without spherical aberration	0.25 ± 0.1	0.25 ± 0.12	0.49
Total HOAs	4.5 ± 1.6	4.46 ± 1.6	0.31
6-mm pupil			
Higher-order RMS	0.44 ± 0.18	0.41 ± 0.15	0.61
Higher-order RMS without spherical aberration	0.41 ± 0.16	0.38 ± 0.15	0.66
Total HOAs	6.5 ± 2.4	6.5 ± 2.2	0.46

CDVA corrected distance visual acuity and AHOAs higher-order aberrations

Myopia was between 0.25 and 10.50 diopters (D) in all cases, with astigmatism ranging from 0.00 to 3.50 D. Patients had a mean age of 36.9±9.4 years old. There were 121 LASIK procedures performed with iris registration and 118 performed without it. Both groups were comparable prior to surgery (Table 2).

Table 2: Preoperative group comparisons of eyes that underwent LASIK with the VISX CustomVue STAR S4 with or without Iris Registration

Parameter	**Mean±Standard Deviation (Range)**		**P Value***
	Iris Registered	**Non-iris Registered**	
BSCVA (logMAR)	-0.04±0.07	-0.05±0.06	.622
SE (D)	-4.28±2.00 (-0.36 to -9.11)	-4.41±1.86 (-0.52 to -8.54)	.594
Sphere (D)	-4.49±2.26 (-0.25 to -10.50)	-4.62±2.08 (-1.00 to -9.75)	.638
Cylinder (D)	0.99±0.76 (0.00 to 3.50)	0.90±0.68 (0.00 to 3.00)	.373

BSVCA = best spectacle-corrected visual acuity, SE = spherical equivalent refraction
*t test.

Efficacy and stability

The mean logMAR UCVA three months after surgery was 0.010.10 in the iris registration group and 0.02 ±0.09 in the non-iris registration group (P=.290) (Table 3).

Eighty percent of patients in the iris registration group and eighty-one percent of patients in the non-iris registration group had UCVA of 20/20 or greater (P=.999).

Table 3: Three-month postoperative results of eyes that underwent LASIK with the VISX CustomVue STAR S4 with or without Iris Registration

Parameter	Iris Registered	Non-iris Registered	P Value
UCVA (logMAR)	-0.01±0.10	-0.02±0.09	.290*
Mean spherical equivalent refraction	0.07±0.37	0.03±0.41	.453*
Mean sphere (range) (D)	-0.08±0.38 (-1.00 to 1.25)	-0.10±0.37 (-1.25 to 1.00)	.700*
Mean cylinder (range) (D)	0.31±0.41 (0.00 to 2.50)	0.26±0.34 (0.00 to 2.25)	.420*
±0.25 D of emmetropia (%)	59	65	.999†
±0.50 D of emmetropia (%)	76	80	.503†
20/20 or better without correction (%)	67	76	.999†
20/20 or better with correction (%)	83	87	.173†

UCVA = uncorrected visual acuity *t test. †Fisher exact test.

After 3 months, the average residual cylinder in the iris registration group was 0.31±0.41 D, whereas in the non-registration group, it was 0.26±0.34 D (P=.42) (Table 2).

CONCLUSION

Results from our research indicate that wavefront-guided LASIK using the VISX CustomVue technology is successful, safe, and predictable, regardless of iris registration status. In our research, we found that FEMTOLASIK, both with and without iris registration, was equally successful in treating myopia with and without astigmatism. There was a substantial and sustained increase in UCVA at 12 months with both methods. This investigation did not find the same positive effects of iris registration technology as had been predicted. The fact that this was not randomized research is only one of numerous possible explanations. The eyes whose iris capture failed during surgery were placed in the non-iris registration group, while the eyes whose iris capture succeeded after surgery were placed in the iris registration group. Myopic and myopic astigmatism patients benefit similarly with FEMTOLASIK with or without iris registration. The VISX STAR S4 CustomVue laser system provides reliable, safe wavefront-guided LASIK regardless of iris registration status.

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