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ACCURACY WITH CUSTOMIZED MYOPIC LASIK AN EFFECTIVE TREATMENT MODALITY FOR HYPEROPIA OR HYPEROPIC ASTIGMATISM

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Abstract

Customized ablation is a relatively new idea in excimer corneal refractive surgery. Customization of excimer ablation for myopic LASIK using a unique automated ray tracing optimization method: safety and effectiveness. Preliminary results for myopic LASIK procedures show that a unique excimer laser customization method based on ray tracing optimization is safe and successful, using a combination of several independent diagnostics and a patient-specific eye model reference. Improved and more reliable visual results may be possible thanks to its potential advantage in entire eye aberration data and ray tracing refraction computation. Hyperopia is the condition in which one has difficulty seeing nearer items yet has no trouble seeing those at a further distance. The purpose of this randomized, controlled research was to evaluate the levels of induced Higher Order Aberrations (HOA) between conventional LASIK and custom LASIK, and to examine the higher order aberrations both before and after surgery in astigmatic myopic patients.

Keywords: Customized Myopic Lasik, Treatment, Hyperopia, Hyperopic, Astigmatism

INTRODUCTION

Nearsightedness, farsightedness, and astigmatism are just some of the most common refractive defects that LASIK has helped millions of individuals across the world cure. With custom LASIK, the cornea is measured using a computer called a wavefront device, which then analyzes aberrations and calculates how to correct them while preserving the cornea's natural overall shape. Although custom LASIK may be customized to accommodate for your unique corneal aberrations, regular LASIK is based on your glasses or contact lens prescription instead. Those who have bespoke LASIK often have less adverse effects, particularly with regards to light distortions and night-driving difficulties. Nevertheless, it is not covered by insurance, is more costly, and may not be any more successful than standard LASIK. Ask your eye doctor whether custom LASIK is a viable choice for you. In laser-assisted in-situ keratomileusis (LASIK), the cornea is surgically reshaped with the aid of lasers to improve eyesight by refracting light more precisely onto the retina. One of the most common forms of refractive error outpatient operations is laser assisted in situ keratomileusis (LASIK), which was given FDA approval in 1998. The cornea, which functions as a lens to focus light on the retina before it travels up the optic nerve to be processed by the brain, is to blame for these misinterpretations. A blurred or doubled picture is sent down the optic nerve if light is not adequately refracted.

Rapid visual recovery, relative lack of discomfort, convenience of executing the treatment, and improved refractive stability (partial only) when it comes to hyperopic treatments have made LASIK the most popular refractive surgical method in the world. The procedure was first introduced in the early 1990s. Customized ablation is a relatively new idea in excimer corneal refractive surgery. By correcting or removing ocular abnormalities, this method often improved visual outcomes. The widespread use of standard ablation in LASIK has prompted widespread interest in determining whether or not standard ablation LASIK and customized ablation vary in terms of visual result and higher order aberration. The purpose of this randomized, controlled research was to evaluate the levels of induced Higher Order Aberrations (HOA) between conventional LASIK and custom LASIK, and to examine the higher order aberrations both before and after surgery in astigmatic myopic patients.

LITERATURE REVIEW

Ye, et al (2016) Laser in situ keratomileusis (LASIK), wavefront-guided LASIK with iris registration (WF-LASIK), femtosecond laser-assisted laser in situ keratomileusis (FS-LASIK), and small incision lenticule extraction (SILE) were studied in 2016 to see how they affected anterior corneal higher-order aberrations (HOAs) (SMILE). Eighty-two eyes had LASIK, 119 eyes had WF-LASIK, 88 eyes had FS-LASIK, and 170 eyes had SMILE surgery in a prospective trial. The Pentacam was used to assess HOAs both before and after surgery, at the 6-month mark. All aberrations were expressed as Zernike polynomials, and the middle 6 mm of the cornea was employed for study of total HOAs, SA, horizontal coma, and vertical coma. All surgeries increase total HOAs and SA in the cornea's anterior region six months after surgery. Although LASIK and FS-LASIK did not significantly vary in the number of HOAs they caused, SMILE caused much less HOAs overall and fewer SA than any of the other two procedures. Along with LASIK and FS-LASIK, WF-LASIK reduced the number of total HOAs while only reducing the number of SA by a statistically significant amount ($P<0.05$). Although there was no statistically significant difference between SMILE and WF-LASIK in terms of the overall number of HOAs and SAs caused, SMILE did cause more horizontal and vertical coma than WF-LASIK did ($P<0.05$). The anterior corneal HOAs caused by FS-LASIK and LASIK were similar. SMILE and WF-LASIK were shown to be superior than LASIK and FS-LASIK in terms of the number of HOAs they caused. As compared to LASIK and FS-LASIK, SMILE has the potential to minimize the induction of SA much more effectively. Yet, more horizontal and vertical coma were caused by SMILE than by WF-LASIK, suggesting that the centration of the SMILE treatment is probably less exact than that of WF-LASIK.

Hieda, et al (2020) Theoretically, a LASIK procedure guided by a "high-resolution" aberrometer has several benefits. Few articles have shown the clinical advantage of wavefront-guided LASIK so far, but these advances are expected to be made in the near future. Using a high-resolution aberrometer, this research aimed to assess the surgical success rate of myopic refractive error correction using wavefront-guided laser in-situ keratomileusis (LASIK). Methods: In this research, 51 eyes from 26 patients (high-resolution group) were monitored for 6 months after undergoing wavefront-guided LASIK using the excimer laser surgical unit and high-resolution aberrometer at the Baptist Eye Institute in Kyoto, Japan between 2012 and 2015. The results of this study were compared to those of our historical control data (early custom group), which spans from 2002 to 2007 and includes 51 eyes from 26 individuals treated with the same amount of correction. Visual acuity (VA), higher-order aberration (HOA), spherical equivalent refractive error (SER), and contrast sensitivity were all factors that were evaluated (CS). High-resolution group patients had a mean SER of -5.86±2.57 diopters (D) and early custom group patients had a mean SER of -5.99±2.52 D, with patients in both groups averaging 33.8±9.2 and 34.3±6.9 years old. High-resolution group was happier with a LogCS of 18 cpd change compared to early custom group. The high-resolution group saw a statistically significant ($P < 0.05$) decrease in spherical aberration after surgery compared to the control group. A post LogCS improvement of 18 cpd was seen after inducing a reduction in spherical aberration. Discussion: While equivalent visual acuity (VA) and refractive precision (RP) results were reported, the high-resolution group tended to gain superior visual function after surgery, suggesting that the newest wavefront-guided LASIK caused fewer HOAs than early custom LASIK.

Pajic, Bojan & Cvejic, Zeljka & Mijatovic, Zoran & Indjin, Dragan & Mueller, Joerg (2017) In this article, we provide the results of a prospective comparative research evaluating the significance of intra-operative dynamic rotational tracking with respect to clinical outcomes during corneal refractive Excimer laser correction, with a focus on the treatment of astigmatisms. Using a comparison of iris images, we were able to calculate the cyclotorsion from the sitting to the lying posture. Patients in Group 1 also received X-Y control, whereas those in Group 2 received just cyclorotational treatment. The average cylinder refraction after surgery was significantly different between the two groups ($p < 0.05$). With a mean of 3.75 degrees and a standard variation of 3.1 degrees, the cyclotorsion may be quantified. The overall amount of torsion ranged between -14.9 degrees and +12.6 degrees. Group 1 had a re-treatment rate of 2.2%, whereas Group 2 had a rate of 8.2%; this difference is statistically significant ($p < 0.03$). The study indicates that LASIK procedures using a dynamic rotational tracking system provide very good predictability in terms of refraction quality, leading to less necessary postoperative treatments.

Prakash, et al (2011) The goal of this study is to evaluate the visual and refractive outcomes of laser in situ keratomileusis (LASIK) performed with and without iris registration, with static preablation iris registration, and with preablation iris registration assisted intra-ablation using dynamic rotational eye tracking. Dr. Agarwal's Eye Hospital in Chennai, India, offers refractive surgery services. Scientific term for a "blinded" clinical experiment. Myopic astigmatic eyes (cylinder >1.00 diopter [D]) were treated with LASIK on the Technolas 217z100 platform. Uncorrected and corrected distant vision acuities, refraction, topography analysis, and a standard LASIK evaluation were all components of the pre- and postoperative evaluations. There was a 6-month follow-up on all patients. Without iris registration, -6.1 D 2.4 (SD), with static iris registration, -6.2 D ±2.3 (P=.4), and with dynamic iris registration, -6.5 D 2.2 (P=.4), preoperatively; with iris registration, -0.27 ±0.4 (SD), -0.12 (SD), and -0.02 (SD) postoperatively (P< .001). Before surgery, the average cylinder error was -2.05 ±0.7 D, -2.08 ±0.5 D, and -2.13 ±0.7 D (P=.6), and after 6 months, it was -0.37 ±0.2 D, -0.29 ±0.2 D, and -0.20 ±0.3 D (P< .001). Comparable target and surgically induced astigmatism were found across the three groups using Alpins analysis; however, dynamic iris registration yielded superior results in terms of the difference vector, error angle, correction index, success index, and flattening index (P <.001). The combination of iris registration and dynamic rotational eye tracking was superior to iris registration alone or no iris registration in correcting myopic astigmatism. Without iris registration, the results were far worse.

INITIAL OUTCOMES WITH CUSTOMIZED MYOPIC LASIK

As the extensive and many papers in the peer-reviewed literature attest, laser-assisted in situ keratomileusis (LASIK) has become one of the most successful and safe procedures for treating refractive error using laser corneal intervention. The mechanical microkeratome has been phased out in favor of bladeless LASIK surgery using a femtosecond laser (named so because of the laser's ultra-short pulses, with duration of few femto-sec, or 10−15 of a sec) to create the lamellar flap. The excimer laser, the second laser used in LASIK, does the ablation, and has also seen substantial development in the previous two decades. Modern excimer lasers for refractive surgery often have high pulse repetition (more than 400 Hz), a flying spot, and individualized ablation strategies such aspheric ablation profiles, wavefront-guided, and topography-guided procedures. Attempting to repair not only the sphero-cylindrical refractive error, but also of the higher-order aberrations, by minimizing generated spherical and other aberrations within the myopic ablations, these advancements have improved the therapeutic results of the LASIK operation.

Myopia, or nearsightedness, is the most prevalent type of refractive error and a growing public health concern throughout the world. Eighty to ninety percent of high schoolers in metropolitan parts of east and southeast Asia are myopic, and 10 to 20 percent have extreme myopia. It is estimated that one billion individuals will have high myopia by 2050, and that half the world's population will have myopia by then. Refractive surgery on the cornea has become the basis of myopia treatment because it is the most easily accessible region of the eye and accounts for two-thirds of the total ocular refractive power. As a common corneal refractive surgery for myopia, laser-assisted in situ keratomileusis (LASIK) has become more popular. To compensate for the larger axial length or excessive refractive power of the myopic eye, a thin-hinged corneal fap is produced and folded back during LASIK, and the exposed stroma is eliminated using an excimer laser. Improved cutting results with minimal distorted fap edge, better prediction of fap thickness, reduced intra-operative, fap-related complications, and improved biomechanical stability have all been observed in femto-LASIK refractive surgery since the introduction of a femtosecond laser for corneal fap creation. Unfortunately, the most common complaints after laser refractive procedures are issues with night vision, including glare, halos, and starbursts.

When the magnitudes of low-order sphero-cylindrical aberrations are decreased, it is believed that high-order aberrations may be induced by the operation, leading to night vision difficulties. The marginal rays of vision in the surgical transition zone tend to diverge when the pupil is dilated to adapt to a low light illumination environment, leading to visual aberrations and a decline in vision quality. In order to lessen the night-time disruptions and boost patient satisfaction, it's crucial to have a firm grasp on the visual performance alterations brought on by refractive surgery. The low- and high-order monochromatic wavefront aberrations of the eye have traditionally been represented by Zernike polynomials. The quality of one's vision is often thought to degrade proportionally to the root mean square (RMS) values of the high-order ocular wavefront aberrations; consequently, wavefront-guided refractive surgery solutions have been developed to decrease the residual RMS values of high-order aberrations in myopic eyes. Unfortunately, the mean squared error (MSE) values of Zernike wavefront aberrations cannot be directly correlated with changes in visual performance. The visual quality (for instance, the modulation transfer function, MTF) and picture quality may be improved by compensating for one term of Zernike aberration with another, as has been established. As an added bonus, some Zernike mode combinations may interact to improve acuity despite an increase in the overall RMS wavefront errors. In contrast to the examination of all the Zernike terms, the RMS values of ocular aberrations are too crude and basic to estimate optical performance. Moreover, describing field-dependent aberrations or chromatic aberrations using the Zernike analysis approach is challenging.

IS LASIK A PROPRIETARY MODALITY FOR THE TREATMENT OF HYPEROPIA OR HYPEROPIC ASTIGMATISM?

Predicting how well an individual will adjust to correct their hyperopia is much more challenging than myopia. Regression after hyperopic correction is much more common than after myopic correction. While photorefractive keratectomy (PRK) has shown effective in treating hyperopia, it is not without drawbacks, including regression, induced astigmatism, and corneal haze. Since it eliminates the risks associated with PRK, LASIK has replaced it as the go-to method for treating hyperopia. Based on what Sheri has heard, the most that can be corrected with LASIK for hyperopia is +5.0D, while the most that can be corrected with LASIK for myopia is +6.0D. The US Food and Drug Administration has given LASIK the green light for treating hyperopia. To correct hyperopia, LASIK creates a steeper central corneal zone (optical zone) and a flatter central corneal periphery (ablation zone) using an annular pattern of ablation.

In an ideal world, everyone's eyes would be perfectly round and functional as optical lenses. Because the eye is rarely perfectly shaped in the real world, clarity of vision is often diminished. The eye has a football-like shape when astigmatism is present. The eye's irregular shape makes it difficult for light to pass through it

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undistorted. Astigmatism affects a large percentage of the population. Astigmatism is a refractive mistake much like nearsightedness and farsightedness and can be rectified with spectacles, contact lenses, or LASIK surgery, despite its huge, rather scary-sounding term. The astigmatism-causing blurriness of vision may be corrected with LASIK thanks to the ultra-precise lasers used in the procedure, which can be programmed to reshape the cornea to make the front surface of the eye more symmetrical. If you have astigmatism, LASIK is usually the only operation you'll need to have it fixed. Even while LASIK can cure high levels of astigmatism, it's possible that another LASIK surgery may be required to get optimal results.

When weighed against traditional correction methods like glasses or contacts, LASIK for astigmatism is a clear winner. Eyeglasses and contact lenses correct for astigmatism by using a lens bent in the opposite direction as the cornea, essentially eliminating the distortion. Unlike LASIK, these treatments for astigmatism-related blurriness, eyestrain, and headaches are only temporary. Moreover, because these lenses are inherently irregular, they might cause severe disorientation. Contacts with astigmatism may potentially become misaligned due to rotation, leading to visual distortion. And there's always the chance that your cornea might become infected, swollen, or damaged by using contact lenses. While doing LASIK in San Clemente on a patient with astigmatism, the surgeon will make a tiny circular hinge incision in the cornea. In this procedure, your surgeon will use a cold excimer laser to restructure the cornea after it has been folded back using a hinged flap. As compared to other refractive operations, LASIK for astigmatism has a relatively high success rate and a quick recovery period, thus many patients choose for it.

Hyperopia is the condition in which one has difficulty seeing nearer items yet has no trouble seeing those at a further distance. Problems with the cornea, the lens, or both may be to blame. Similar to how farsightedness is the reverse of this disease (myopia). A failure to properly concentrate light entering the eyes results in farsightedness. Normally, light enters the eye and is focused onto the retina, the light-sensitive tissue at the rear of the eye, but in this case, it is focused behind the retina. If your farsightedness is the consequence of a refractive defect, LASIK may be an effective treatment option for you. If your farsightedness is caused by a corneal irregularity, then LASIK may be able to help. During LASIK surgery, the corneal tissue is reshaped to ensure that incoming light is focused precisely on the retina. In most cases, LASIK is not a good choice of therapy for farsightedness if the cause is due to the lens's form or curvature.

CONCLUSION

We can say that Hyperopia and hyperopic astigmatism of low to moderate degrees are effectively treated by LASIK surgery, which is safe, predictable, stable, and successful. The astigmatism-causing blurriness of vision may be corrected with LASIK thanks to the ultra-precise lasers used in the procedure, which can be programmed to reshape the cornea to make the front surface of the eye more symmetrical. In order to enhance your eyesight and lessen your reliance on glasses or contacts, you may want to consider LASIK, a popular kind of laser eye surgery. The widespread use of standard ablation in LASIK has prompted widespread interest in determining whether or not standard ablation LASIK and customized ablation vary in terms of visual result and higher order aberration. The unique diagnostic tool and surgical approach integrate wavefront, Scheimpflug tomography, and interferometry axial length measurements to perform a ray tracing computation, which seems to provide safe and successful visual results for myopic LASIK.

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