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A STUDY ON SPHERICAL ABERRATIONS AFTER CONVENTIONAL LASIK IN MYOPIA.

Ophthalmology

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ABSTRACT

In present study, postoperative data were taken at 1 month, 3 and 6 months after surgery. The aim of our study was to study the changes in spherical aberration after conventional laser in situ keratomileusis (LASIK). The study was a prospective, observational study. 56 myopic eyes of 29 patients undergoing LASIK were studied. All patients were clinically evaluated for the visual acuity (uncorrected and best corrected), retinoscopy, corneal topography, wave front analysis with Hartmann-Shack wavefront analyzer, anterior segment optical coherence tomography(OCT), ultrasonic pachymetry and dilated retinal evaluation. Statistical analysis was performed using *SPSS 15.0. Paired-samples t test, Wilcoxon Signed Ranks Test* were applied. A P value of less than 0.05 was considered statistically significant. Our results showed that conventional LASIK treatment significantly induced the spherical aberration (Z 4, 0) for 1 month. Conclusion: Conventional LASIK significantly increases the postoperative spherical aberrations at 1, 3, and 6 months.

KEYWORDS

Wavefront Analysis, Refractive surgery, Contrast Vision.

INTRODUCTION

Over recent years, a number of procedures in have offered an alternative for glasses or contact lenses. One of the most popular is Laser Assisted in-Situ Keratomileusis(LASIK). The objective of LASIK is to reduce the eye's refractive error , hence decreasing the dependence on glasses and/or contact lenses. Refractive surgery focuses on spherocylindrical errors correction. Unfortunately, these corrections increase in higher-order aberrations Previous studies have demonstrated that LASIK significantly increases higher-order aberrations [1–9], mainly spherical aberrations[9-13] The purpose of this prospective study was to investigate the spherical aberrations of eye caused by conventional LASIK.

Subjects and Methods: A prospective, observational study was done in 56 myopic eyes of 29 patients in Swastik Netralaya, Ahmednagar. All patients undergoing LASIK were recruited over a period of six months from Jan 2018 to June 2018 and were followed up for a period of 6 months. **Inclusion criteria** were Patients aging more than 18 years, Patients having treatable refractive error (Myopia-1 to-10 Diopter), Patient should have a pachymetry of more than or equal to 500 microns, Patients should have a clear cornea with no other ocular pathology, Patients willing to participate in this study, Ability and willingness to provide informed consent.

EXCLUSION CRITERIA: were Age less than 18 years, Thin Cornea (< 500 micron), Any Corneal pathology, Any Lenticular pathology, Any Retinal pathology, Intra operative complications like free cap, button holing etc. , Severe dryness, Cases undergoing Wavefront guided LASIK, Patients not willing to participate in this study.

METHODOLOGY

All patients were clinically evaluated for the visual acuity (uncorrected and best corrected), retinoscopy, contrast sensitivity testing, corneal topography, wave front analysis with Hartmann-Shack wavefront analyzer, anterior segment optical coherence tomography(OCT), ultrasonic pachymetry and dilated retinal evaluation. All cases were done by same experienced corneal surgeon under same surgical conditions. A written informed consent was obtained from all patients, after having explained to them the nature of the treatment, the procedure being performed, and the possible consequences therein. The following parameters were recorded pre-operatively:

1) **Best corrected visual acuity**- Refraction assessed objectively by retinoscopy and autorefractometer, and then confirmed subjectively, further recorded by Snellen's acuity charts and equivalent logMAR values.
2) **Wave Front Analysis** - this was done in all patients to see the aberrations of the eyes mainly spherical aberrations (Z_4^0) with using Hartmann-Shack wavefront analyzer (WASCA, *Carl Zeiss Meditec AG 07740 Jena, Germany*).
3) **Corneal thickness**

a. Anterior Segment OCT-was done in all patients to see the global pachymetry values of both the eyes. (*Visante, Carl Zeiss Meditec Inc. Dublen, CA, USA*),
b. Ultrasonic Pachymetry (Pachymate) - was done to see the thickness at the centre of the cornea.

4) **Corneal topography**- Simulated Keratometry values were determined using the ATLAS Corneal Topography System featuring MasterVue Software, Zeiss.
5) **Slit lamp evaluation**- A detailed clinical evaluation of anterior segment was done, looking out for clinical signs, using the Topcon Slit Lamp, Model SL 1E. Intraocular pressure was measured with Goldmann Applanation tonometer.
6) **Dilated Retinal Evaluation** - a dilated fundus examination was done using an indirect ophthalmoscope (Heine Model D40 Omega 2c) and a Volk +20D lens to look for any retinal holes or tears which were lasered prior to the LASIK procedure.

PROCEDURE

Preoperatively–All patients posted for surgery were given Moxifloxacin eye drops (Vigamox, Texas, USA) four times a day in both eyes for 2 days before surgery. **Anaesthesia** – All the procedures were performed under topical anaesthesia with 0.5% Proparacaine eye drops. **Preparation** – The eye lashes were removed from the operative field with a sterile sticking tape and draping was done. **Surgical Technique** – Speculum was applied to the lids.The automated microkeratome (Moria- one use-plus SBK head 90 micron head or 130 micron head) suction ring was fixed on the eye. The intraocular pressure was sufficiently raised which was checked by barraquer tonometer. The desired flap of 90 microns or 130 microns was made with the automated one use disposable microkeratome headThe flap was then raised. The bed was dried Excimer laser photoablation was done (Carl Zeiss, Mel 80). The flap was reposited. **Post operatively** - All patients were given Moxifloxacin 0.5% four times a day for one week, Prednisolone acetate 1% eye drops four times a day for one week and lubricating eye drops for three months. **Follow up** – Patients were followed up on first postoperative day, at one week, one month, 3 months and 6 months. At each visit visual acuity was noted along with refraction and slit lamp evaluation of the anterior segment. Wave front analysis was performed at each visit.

Results:

Patients and Eyes – We studied 56 eyes of 29 patients, who underwent an uneventful LASIK.

Demographic Data

Table 1 - Sex

Sex	Number	Percentage
Males	10	34%
Females	19	66%

This study included 29 patients in which 10 were males and 19 were females

Table 2 - Laterality

Side	Number	Percentage
Right eye	28	50%
Left eye	28	50%

Table 3 - Age

	No. of eyes	Min.	Max.	Mean
Age	56	19	46	27.62

The average age of patients was 27.62 years (range, 19 - 46 years).

Table 4 - Simulated keratometry

Mean	Standard Deviation	Min.	Max.
44.44	1.68	40.87	47.93

Average simulated keratometry value was 44.44 ± 1.68D (range, 40.87 to 47.87)

Table 5 - Ultrasound pachymetry

Mean	Standard Deviation	Min.	Max.
556.83	32.81	500	624

Average ultrasound central corneal pachymetry was 556.35 ± 33.35 (range, 500 to 624).

Table 6 - Change in visual acuity after LASIK (logMAR values)

Visit	Mean	SD	p value
Pre-operative (BCVA)	0.00	0.0	
1 month (UCVA)	-0.096	0.0	0.00
3 months (UCVA)	-0.096	0.0	0.00
6 months (UCVA)	-0.096	0.0	0.00

BCVA: Best corrected visual acuity
UCVA: Uncorrected visual acuity

LASIK significantly improved visual acuity at 1, 3 and 6 months after the procedure compared to the best corrected visual acuity at baseline. After LASIK, mean logMAR visual acuity at 1, 3, and 6 was -0.096, -0.096, and -0.096 respectively. Student's paired t test was used.

Table 7 - Change in refractive error (spherical equivalent)

Visit	Mean (Diop-tres)	SD (Diop-tres)	p value
Pre-operative	-4.59	2.61	
1 month	-0.022	0.26	0.00
3 months	-0.002	0.16	0.00
6 months	-0.009	0.16	0.00

LASIK significantly reduced the refractive error. 94.64% of eyes were within 0.25D of the intended correction. After LASIK, mean spherical equivalent at 1, 3, and 6 was -0.022, -0.002 and -0.009 respectively. Statistically significant difference was found at 1st month (p=0.00), 3rd month (p = 0.00) and 6th month (p=0.00). Student's paired t test was used.

Table 8 - Change in spherical aberration (Z 4,0)

Visit	Mean	SD	P value
Preoperative	-0.21	0.15	
1month	-0.57	0.48	0.00
3months	-0.50	0.50	0.00
6months	-0.46	0.50	0.00

Spherical aberration (Z 4,0) was significantly increased after LASIK (2.71 folds at 1 month, 2.38 fold at 3 months and 2.19 folds at 6 months), Paired t test, p value < 0.05.

After LASIK, mean spherical aberration at 1, 3, and 6 months was -0.57, -0.50, and -0.46 respectively. Statistically significant difference was found at 1st month (p=0.00), 3rd month (p = 0.00) and 6th month (p=0.00). Student's paired t test was used.

DISCUSSION:

As refractive surgery evolves, laser in situ keratomileusis (LASIK) has gained widespread popularity as the procedure of choice to correct refractive errors. LASIK can reduce refractive error and improve uncorrected visual acuity, but several problems must be resolved regarding postoperative ocular aberrations and visual function.

Previous studies have demonstrated that laser in situ keratomileusis (LASIK) significantly increases higher-order wavefront aberrations of the eye [1–9], mainly spherical aberrations [9-13]

Oshika T et al.[1] conducted a prospective randomized study, 22 patients with bilateral myopia received photorefractive keratectomy on one eye and laser in situ keratomileusis on the other eye. Oshika et al found an increase of 3rd and higher order corneal aberrations (2.7-fold for LASIK and 2.3-fold for PRK), with respect to preoperative values in the same eyes. Both photorefractive keratectomy and laser in situ keratomileusis increase the wavefront aberrations of the cornea and change the relative contribution of coma- and spherical-like aberrations. For a large pupil, laser in situ keratomileusis induces more spherical aberrations than photorefractive keratectomy.

In present study we found that Spherical aberration (Z 4,0) were significantly increased after LASIK (2.71 folds at 1 month, 2.38 fold at 3 months and 2.19 folds at 6 months). After LASIK, mean spherical aberration at 1, 3, and 6 months was -0.57, -0.50, and -0.46 respectively. Statistically significant difference was found at 1st month (p=0.00), 3rd month (p = 0.00) and 6th month (p=0.00). Pair t test was used for statistical analysis.

Loukotova V **et al.**[14] studied patients treated by means of refractive LASIK treatment. The authors analyzed 51 eyes (31 patients). Authors concluded that the after conventional LASIK treatment induction of higher order aberrations was twice as much and was directly correlated to the degree of the laser correction. The spherical aberration was four-times higher comparing to the preoperative values and was independent to the level of the initial refractive error.

In our study we found that conventional LASIK significantly induced spherical aberration, in good agreement with previous studies [1-13]

In the current series of patients, there was no case with obvious corneal haze, elevated intraocular pressure, retinal problems, or other complications that may affect postoperative visual function.

CONCLUSIONS

Conventional LASIK significantly increases the postoperative spherical aberrations at 1, 3, and 6 months.

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