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EFFECT OF LASIK SURGERY ON INTRAOCULAR PRESSURE (IOP) IN MYOPIC PATIENTS

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ABSTRACT

Introduction: Intraocular pressure is the lateral pressure exerted by intraocular contents above the atmospheric pressure. IOP decrease can be dramatic in highly myopic corrections. Preoperative IOP is the single strongest predictor of postoperative IOP change, with eyes with higher preoperative IOP having greater IOP decrease. LASIK correction will lower IOP by ~1 mmHg because of the effect of the lamellar flap. **Objective:** To assess the intraocular pressure of myopic patients before and after LASIK surgery. **Materials and Methods:** This prospective, observational, pre and post interventional study was conducted in Bangabandhu Sheikh Mujib Medical University (BSMMU), and LASIK SIGHT CENTRE, Gulshan, Ophthalmological Society of Bangladesh (OSB) Laser Visior Centre, Mirpur-2, Dhaka for a period of one year starting from January 2007 to December 2007. A total 40 patients of 80 eyes were evaluated with a view to assess the effect of Laser in situ keratomileusis (LASIK) surgery on intraocular pressure in myopic patients. Group I: IOP before LASIK surgery. Group II: I0P after LASIK surgery. **Observations and Results:** A total 40 patients of 80 eyes were evaluated with a view to assess the effect of Laser in situ keratomileusis (LASIK) surgery on intraocular pressure in myopic patients. The mean age of the study patient is 25.16±6.33. The number of patients below 30 years of age is and above 30 years of age. Out of 40 patient 24 were female and 16 were male. The mean distribution of 10P of study eyes. The mean SD pre LASIK IOP left eye 11.5±.1.54 mm Hg. After 28th days of operation it was decreased to 10.25±1.34 mmHg. The mean SD pre-LASIK IOP right eye 11.65±1.45 mm Hg. After 28th days of operation it was decreased to10.27±1.33 mm Hg. Majority of the patients were in state of high myopia. **Conclusion:** The difference between the mean pre and post-LASIK measurements of IOP by Goldmann Applanation tonometer was 1.32 mm Hg, which was significant (P< 0.001). None of the operated eyes had a postoperative IOP higher than the preoperative measurements, after LASIK. Surgeon should be aware of possible change in measurement of IOP with the change of corneal thickness.

KEYWORDS: Intraocular pressure calculation, Post-LASIK glaucoma, Goldmann applanation tonometry, Glaucoma.

I INTRODUCTION

Intraocular pressure is the lateral pressure exerted by intraocular contents above the atmospheric pressure. Pooled data from large epidemiologic studies indicate that the mean IOP is approximately 16mmHg with a standard deviation of 3 mmHg.[1] Factors affecting the I0P-time of day, heartbeat, respiration, exercises, fluid intake, systemic medications and topical drugs. IOP is higher when the patient is recumbent rather than upright. In normal individual IOP varies 2-6 mmHg over a 24 hrs. period, as aqueous humor production changes. Applanation tonometry measurements are also affected by the central corneal thickness (CCT). The Goldmann tonometer is most accurate with a CCT of 520µm. Increased CCT may give an artificially high and decreased CCT may give an artificially low, IOP measurement. IOP measured after photo refractive keratectomy (PRK) and laser in situ keratomileusis (LASIK) may be reduced because of changes in the corneal thickness induced by these and other refractive procedures. It can be estimated that for every 10µm difference in CCT from the population mean (approximately 542 µm), there is a 0.5mm Hg difference between actual IOP and IOP measured with a Goldmann tonometer.[2] Several study show that Goldmann applanation tonometry (GAT) readings after LASIK

under estimate intraocular pressure (IOP). This under estimation is reported after myopic and hyperopic LASIK.[3] The under estimation of IOP after LASIK by commonly used loss. This is particularly true in the early postoperative period because of the hypertensive effect of corticosteroids. There is evidence that corneal rigidity is altered after LASIK. The deposition of new collagen during the healing process can alter normal corneal rigidity. Patel and Aslanids propose that the increase in proteoglycane and hyaluronic acid that occurs after excimer laser photo ablation causes increased accumulation of water in the stroma and this change in hydration could affect corneal rigidity.[4] Myopia is an important public health problem in several Asian countries and available data suggest that both prevalence and severity of myopia have increased significantly over the past two decades.[5] Although vision can be restored to 6/6 with spectacles or contact lenses in the most myopic persons, many are willing to submit to LASIK procedure, a form of refractive corneal surgery, because of its promise of an unaided vision.[6] LASIK is a relatively new ophthalmic procedure that represents a combination of previously used techniques (The accuracy of photo refractive keretectomy with the healing advantage of automated lamellar keratoplasty) in refractive surgery.[7] LASIK involves the use of a microkeratome to create a thin corneal flap followed by Excimer Laser ablation of the corneal stroma and repositioning of the flap.[8,4] This observation is to show the change of I0P after LASIK surgery in myopic patient due to change in central corneal thickness.

II AIMS AND OBJECTIVES

General Objective

To assess the intraocular pressure of myopic patients before and after LASIK surgery.

Specific Objective

To assess central corneal thickness before and after LASIK surgery.

III MATERIALS AND METHODS

Place of the study: Bangabandhu Sheikh Mujib Medical University (BSMMU), and LASIK SIGHT CENTRE, Gulshan, Ophthalmological Society of Bangladesh (OSB) Laser Visior Centre, Mirpur-2, Dhaka, Bangladesh.

Period of study: From January 2007 to December 2007.

Type of study: prospective, observational and interventional study.

Study population and sample sources: 40 patients after LASIK surgery

Method of sample collection: It is a prospective study. A pre-designed protocol was approved by Bangladesh College of Physicians and Surgeons which include the following method.

Group I: IOP before LASIK surgery

Group II: IOP after LASIK surgery

Criteria for selection of patients

1. Inclusion criteria

a) Sex: Both sexes
b) Age: 18 years to 40 years

2. Exclusion criteria

a) Patients with known allergy to topical eye drops.
b) Patients taking medications that may interfere with intraocular pressure.
c) Patients with a history of previous ocular surgery.

Follow up schedule

- Follow up after 4 weeks
- Slit lamp examination
- Intraocular pressure
- Pachymetry

Statistical analysis: History and clinical findings were collected by pre designed structured data collection sheet. Statistical analysis were done by using computer software. The results of the outcome measurement were calculated, analyzed by paired t-test and compared between two groups.

- A probability value
- $P<0.05$ was considered significant
- $P<0.001$ was considered as highly significant
- $P>0.05$ was considered non-significant.

Myopia and Options for its management

Myopia (or short sightedness) is that form of refractive error where in parallel rays of light come to a focus in front of the sentient layer of the retina when the accommodation is at rest.[9,10] Myopia is the most common refractive error throughout the world. 20% of Singapore children are myopic at 7 years at the start of their primary education with prevalence exceeding 70% upon completing college education.[11,12] Other population based studies showed myopia prevalence of 15% in preschool 4 years old children[13], 80% in military conscripts[14], and nearly 40% in adult Chinese aged 40 and older.[15] This is 1.5-3 times higher than similarly aged white black populations in the United States and elsewhere.[16,17]

Etiologically myopia related with

- **Axial length** of the eye.
- **Curvature** of the cornea.
- **Refractive index** of crystalline lens.

Myopia, like other types refractive error, can be subdivided into simple and Pathological myopia.

Lasik

Excimer laser is a high-energy ultraviolet laser used to ablate corneal tissues. The gas composed of two separate molecules of Argon fluoride that emits ultraviolet light with a wavelength of 193nm. The UV photons break up the intra-molecular bonds with minimal thermal damage to the surrounding structures known as photo-ablation" or "photodecomposition". Each laser pulse ablates a tissue layer of 0.25 µm thick and converts it into a

gaseous material. LASIK is being used to treat-Myopia, Hypermetropia, Presbyopia and Astigmatism.

Advantage of LASIK
Minimum patient discomfort
Rapid healing
Early visual rehabilitation
Minimal corneal haze
Better predictability
Used for correction of all types of refractive error.

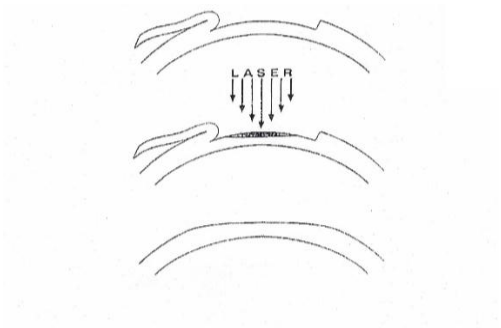

Figure 1: Schematic representation of LASIK Surgery.

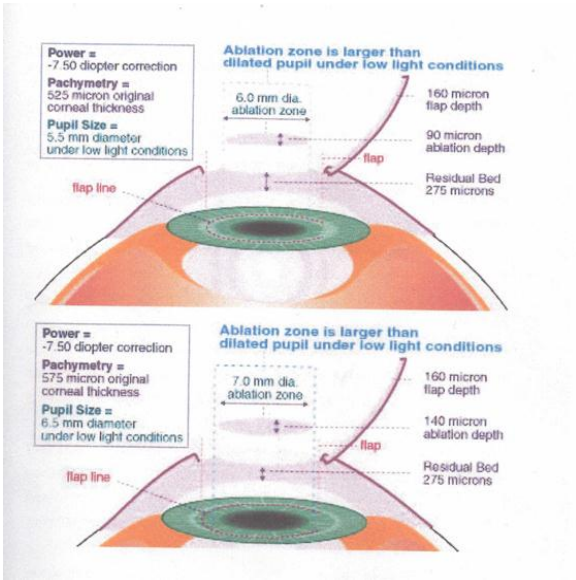

Figure-2: Schematic representation of LASIK Surgery.

Table I: Age-descriptive statistic (N=40).

	N	Minimum	Maximum	Mean	Std. Deviation
Age	40	18	40	25.16	6.339

[Table-I] Shows the age distribution of the study patients. The mean age of the study patient is 25.16±6.33. The number of patients below 30 years of age is and above 30 years of age.

Table 2: Age distribution of patients (N=40).

Age	No	%
18-30	29	73
30-40	11	27

Pre-Operative Assessment
History: Stability of refraction- It is important to make sure that the refractive error of a LASIK candidate is stable. LASIK is usually performed in candidates who are 18 years or older as at this age the refractive status of the eye has often stabilized and informed consent can be given.

Contact lens wear: Contact lens wearers are advised to discontinue the use of their lenses (for at least 1 week in the case of soft lens users and 4 weeks in the cast of hard/RGP lens users) prior to surgery.

Medical and ophthalmic conditions: The suitability of a candidate for LASIK surgery may be affected by a number of ocular and systemic conditions. These may be include active corneal or ocular surface disease, central corneal revascularization, uncontrolled glaucoma, Presence of bleb after glaucoma filtering surgery, diabetic retinopathy requiring laser therapy, sunken eyes or eyes with a narrow palpebral aperture, dry eye, pregnancy, systemic vascular and autoimmune diseases which are likely to effect wound healing.

IV OBSERVATIONS AND RESULTS
This prospective observational pre and post interventional study was conducted in Bangabandhu Sheikh Mujib Medical University (BSMMU), and LASIK SIGHT CENTRE Gulshan Ophthalmological Society of Bangladesh (OSB) Laser Visior Centre, Mirpur-2, Dhaka for a period of one year starting from January 2007 to December 2007. A total 40 patients of 80 eyes were evaluated with a view to assess the effect of Laser in situ keratomileusis (LASIK) surgery on intraocular pressure in myopic patients.

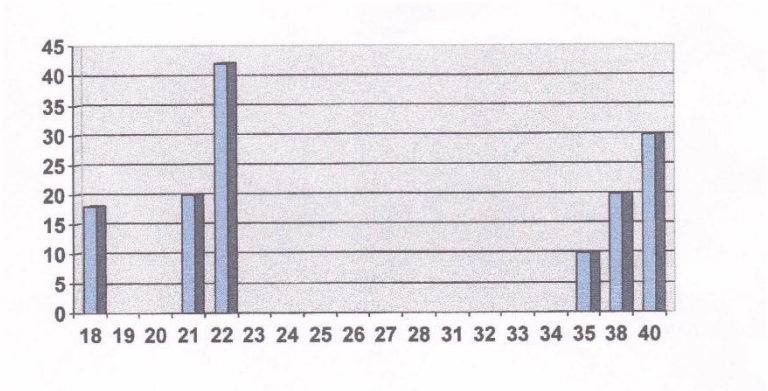

Figure 3: Bar chart shows the age distribution of the study patients.

Table 3: Sex distribution of the study patients showing male and female distribution (N=40).

Sex	Frequency	Patient (%)
Male	16	25
Female	24	75
Total	40	100

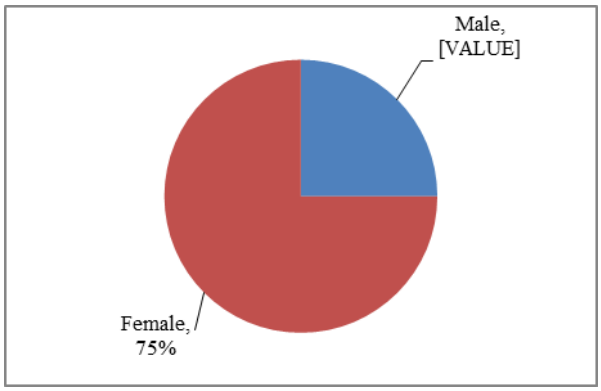

Figure 4: Pie chart shows the sex distribution of the study patients.

Out of 40 patient 24 were female and 16 were male [Figure-4].

Table 4: Shows the occupational status of the studied patients (N=40).

Occupation	No	Percentage (%)
Student	20	50
House Wife	10	25
Service	7	17.5
Business & others	3	7.5
Total	40	100

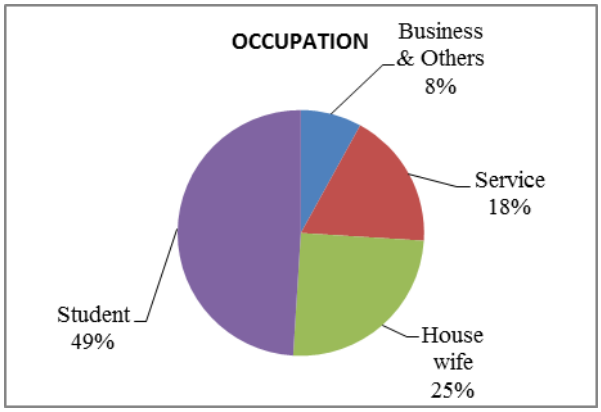

Figure 5: Pie diagram of the studied patients showing majority of the patients were in student young group.

Table 5: Showing status of myopia of the studied patients (N=40).

Myopia	No	Percentage (%)
Low myopic status(-2 to -3 diopter)	15	18.75
Moderate myopic status(-3 to-6 diopter)	30	37.5
High myopic status(-6 to -10 diopter)	35	43.75
Total	80	100

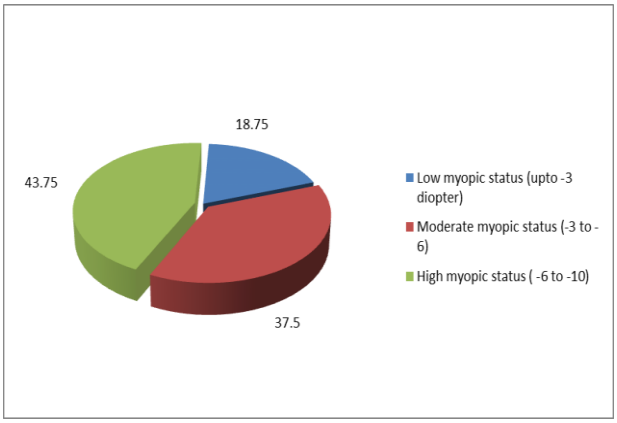

Figure 6: Pie diagram of the 80 studied eyes of 40 patients.

Showing majority of the patients were in state of high myopic [Figure-6].

Table 6: Mean distribution of IOP values right eye (N=40).
IOP measurements

Pre and post-operative follow up	N	Mean	SD	P value
Pre-LASIK	40	11.65	1.45	
28th days	40	10.27	1.33	<0.001
P value reached from paired t test. Pre-LASIK vs. Post LASIK surgery after 28th days; t= 6.738, df=40, ***p<0.001				

[Table-6] shows the mean distribution of I0P of study eyes. The mean ± SD pre-LASIK IOP right eye 11.65±1.45 mm Hg. After 28h days of operation it was decreased to 10.27±1.33 mmHg.

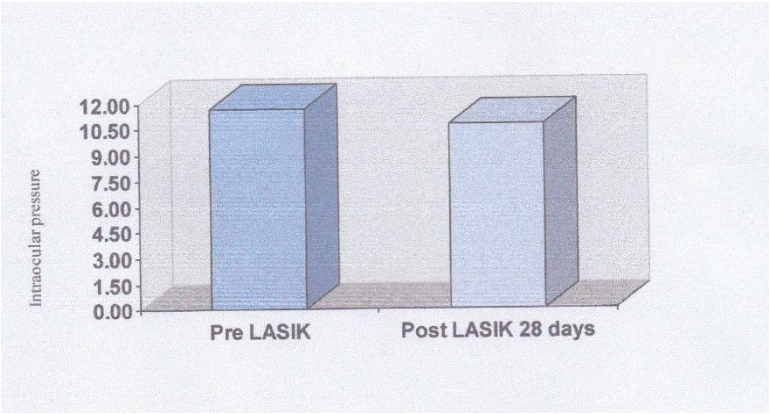

Figure 7: Shows the mean distribution of IOP of study eyes.

Table 7: Mean distribution of IOP values left eye (N 40).

Pre and post-operative follow up	N	Mean	SD	p value
Pre-LASTK	40	11.51	1.5	
28 days	40	10.25	1.34	<0.001
Value reached from paired t test, Pre-LASIK vs. Post LASIK surgery after 28 days, t-5.85, df-40, ***p<0.001				

Shows the mean distribution of IOP of study eyes. The mean ± SD pre LASIK IOP left eye 11.5 ± .1.54 mm Hg. After 28 days of operation it was decreased to 10.25±1.34 mmHg [Table-7].

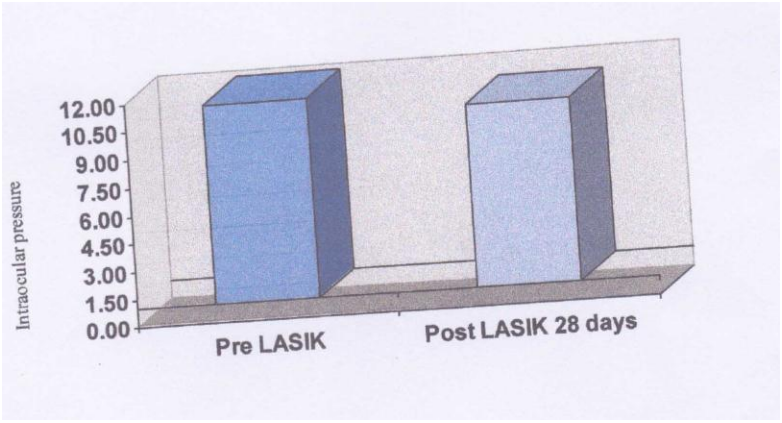

Figure 8: Shows the mean distribution of IOP of study eyes.

Table 8: Mean distribution of CCT values right eye (N-40).
Central corneal thickness measurement

Pre and post-operative follow up	N	Mean	SD	P value
Pre-LASIK	40	506	42.94	
28th days	40	470	21.52	<0.001
P value reached from paired t test. Pre-LASIK vs. Post LASIK surgery after 28th days; t 22, df 40, ***p<0.001				

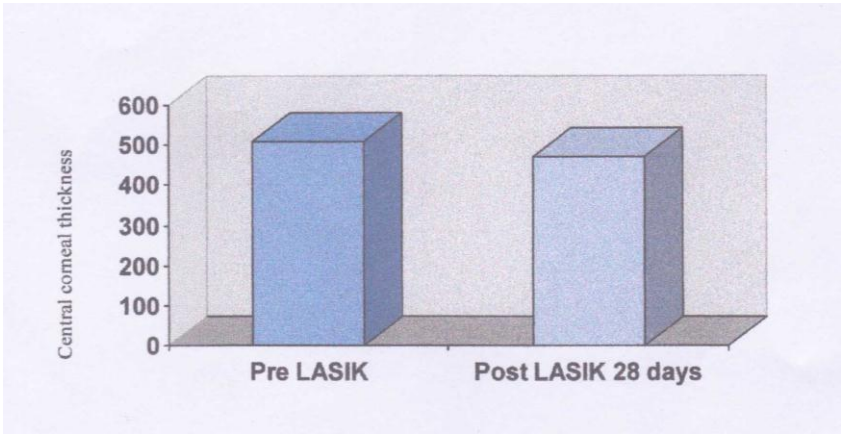

Figure 9: Shows the mean distribution of CCT of study of right eyes.

Table 9: Mean distribution of CCT values left eye (N-40).
Central corneal thickness measurement

Pre and post-operative follow up	N	Mean	SD	P value
Pre-LASIK	40	507	43	
28h days	40	472	22	<0.001
P value reached from paired t test. Pre-LASIK vs. Post LASIK surgery after 28th days; t=22, df=40, ***p<0.001				

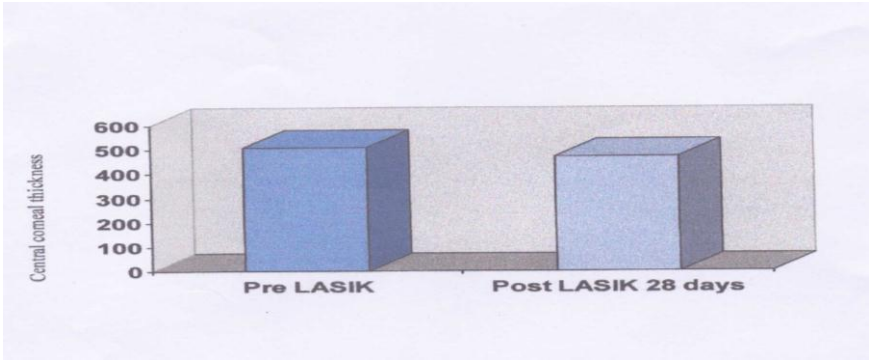

Figure 10: Shows the mean distribution of CCT of study of left eyes.

V DISCUSSION

Evaluation of IOP is a fundamental part of ocular examination in both health and disease. IOP measurement is not only important in the diagnosis and management of glaucoma, but its assessment is important in the management of corneal, lenticular, uveal, and retinal diseases. Currently, the most common way to assess IOP is by Goldmann applanation tonometry, which is considered the standard method for measurement of IOP. Goldmann applanation tonometry gives accurate measurements of IOP in eyes with normal corneal curvature, and with normal (average) corneal thickness of 520 µm. Laser in situ keratomileusis (LASIK) has become an accepted method to treat many refractive errors. Recent studies have shown that it is a safe, effective, and predictable procedure for the correction of myopia and myopic astigmatism. Among various refractive error, Myopia is one of the common causes of visual disturbance among our population. Although myopia can be corrected totally by spectacle and contact lenses, many patients eager to have good unaided vision by alternate method. There has been improvement and invention of modern technique to properly manage this problem so as to offer clear vision as much as near normal. LASIK is becoming one of the most common refractive techniques to correct myopia. All refractive surgery procedures must satisfy several basic principles in order to satisfy not only the critical evaluation of the eye care professional, but, more importantly, the exacting needs of the patient. The five basic objective data points by which refractive (LASIK) procedures are evaluated 1.Predictability, 2. Uncorrected visual acuity with the preoperative visual potential considers 3. Best corrected visual acuity, 4. Stability of refraction and 5. Safety, Two additional points that must be observed to deliver a satisfactor outcome area a. quality of vision and b. subjective patient satisfaction. Though LASIK surgery fulfill most of the criteria, at the same time newer complications also developed and surgeon have to face them and solve them. This prospective observational pre and post interventional study had been designed to evaluate the "Effect of Laser in-situ keratomileusis on IOP measurement in myopic patients". This study was the first attempt in Bangladesh to observe the changes of IOP before and after LASIK surgery in myopic patients. In this study, 80 eyes of 40 patients who were suffered from myopia. Forty four patients underwent bilateral LASIK surgery. The age of the patients ranged from 18-40 years, with a mean of 25.5 years. Eighteen patients were male and thirty two patients were female. As female are more conscious so their propensity for LASIK is more. The preoperative refraction ranged from -2 to -10 D (diopters) and the mean spherical equivalent was -5.4D. As the number of patients undergoing LASIK increases, there is concern about the accuracy of intraocular pressure (IOP) measurements after excimer laser refractive surgery. Goldman applanation tonometry is considered the standard method for assessment of IOP, and is used routinely in ophthalmic practice. In this study, the mean distribution of I0P of study eyes mean SD pre-LASIK IOP right eye 11.65±1.45 mm Hg. After 28th days of operation it was decreased to10.27±1.33 mmHg. P value reached from paired t test and P value is <0.001 and the mean distribution of CCT of study eyes is 506± SD of pre-LASIK CCT right eye was 42.94. After 28th days of operation it was decreased to 470±21.54.P value is <.001 which is highly significant. The mean distribution of 10P of study eyes. The mean SD pre LASIK IOP left eye 11.5±.1.54 mm Hg. After 28th days of operation it was decreased to 10.25±1.34 mmHg. P value reached from paired t test and p value is <0.001 and the mean distribution of CCT of study eyes is 507±SD of pre-LASIK CCT left eye was 43. After 28th days of operation t was decreased to 472±22, P value is <.001 which is highly significant. Measurements of IOP by Goldmann applanation tonometry are influenced by corneal thickness and to a lesser extent by corneal curvature. In a normal population, thin corneas tend to give lower readings (underestimation) by Goldman applanation tonometry, whereas thick corneas are associated with elevated readings (overestimation). Previous studies reported decreased corneal thickness in many cases of low-tension glaucoma, and increased corneal thickness in cases of ocular hypertension. Studies also showed a positive correlation between IOP measurements by Goldmann applanation tonometry and increasing corneal curvature. Thus, flat corneas can cause the I0P measurement to be underestimated by Goldman applanation tonometry. LASIK for myopia (and myopic astigmatism) alters corneal parameters including central corneal thickness and corneal curvature, hence LASIK can change the accuracy of IOP measurements by Goldman applanation tonometry. This study prospectively evaluates the changes that occur in IOP measurements by Goldman applanation tonometry after LASIK for myopia and myopic astigmatism. Same type of study (IOP after LASIK) done by Emara B, Probst LE, Tingey DP.[18] In the untreated group of 288 eyes mean CCT was 544.0 microns 37.3 (SD) (range 461 to 664 microns) and mean IOP, 15.±2.7 mm Hg (range 10 to 24 mm Hg). The correlation between IOP and CCT in this group was highly significant ($r = 0.44$, $P < .0001$). In the Post-LASIK group, mean CCT dropped approximately 73.0 microns to 479.5±41.2 microns (range 408 to 503 microns) and IOP dropped to a mean of 13.6±3.3 mm Hg (range 7 to 22 mm Hg). A significant correlation was found between IOP and CCT after LASIK ($r= 0.33$; $P<.002$). The difference between the mean pre- and Post-LASIK measurements of applanation IOP was 2.5 mm Hg, which was significant ($P<0.001$) Central corneal thickness is an important variable in the evaluation of applanation IOP and should be included in the assessment of any case of potential glaucoma or ocular hypertension, particularly in eyes with previous photoablative refractive surgery. Another prospective comparative study was done by Wolfs RC Klaver CC.,[19], there were no differences between sexes and no significant association with age. Omer F. Recep Md.,[20], showed in this study laser in situ keratomileusis

was associated with a mean decrease in pachymetry of 46.7 µm±28.9 (SD) and a mean decrease in IOP of 2.8±2.1 mm Hg. There was a significant correlation between the decreases in IOP and pachymetry (P<.001). Omer F. Recep Md.,[20], showed in this study laser in situ keratomileusis was associated with a mean decrease in pachymetry of 46.7 pm ±28.9 (SD) and a mean decrease in IOP of 2.8 ±2.1 mm Hg. There was a significant correlation between the decreases in IOP and pachymetry (P<.001). Measurements of IOP by Goldman applanation tonometry at the central part of the cornea ranged from 7 to 20 mmHg with a mean of 12.63± 2.69 mmHg. At 1 year after LASIK, IOP measured by Goldmann applanation tonometry at the center of the cornea ranged from 4 to 14 mmHg (mean, 8.94 ±2.13 mmHg). Comparing the IOP measurements at the center of the cornea among the different postoperative examinations, there were no significant changes during the 12-month period of follow-up (P>.05). None of the operated eyes had a postoperative IOP higher than the preoperative measurements. After LASIK, IOP measured by Goldmann applanation tonometry at the center of the cornea was reduced by a mean of 3.69±1.63 mmHg (range, 0 to 9 mmHg), compared to preoperative measurements. The decrease of IOP after LASIK was statistically significant.

VI CONCLUSION

The difference between the mean pre and Post-LASIK measurements of applanation IOP was 1.32 mm Hg, which was significant (P<.0001). Central corneal thickness is an important variable in the evaluation of applanation IOP and should be included in the assessment of any case of potential glaucoma or ocular hypertension, particularly in eyes with previous photo ablative refractive surgery. None of the operated eyes had a postoperative IOP higher than the preoperative measurements, after LASIK. The aim is to improve the refractive status of the patient. Surgeon should be aware of possible change in measurement of IOP with the change of corneal thickness.

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