A STUDY OF CHANGE IN INTRAOCULAR LENS POWER AFTER CORNEAL REFRACTIVE SURGERY

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ABSTRACT

Introduction: LASIK is one of the most commonly performed refractive surgeries worldwide because of patient's comfort and surgeons skills. This young generation undergoing LASIK surgery will also have to undergo cataract surgery in their old age. Patients undergoing cataract surgery require intraocular lens (IOL) calculation for the IOL implantation. As LASIK changes the corneal curvatures the keratometry and effective lens position will be affected leading to change in IOL power. This study aims to identify the change in IOL power after LASIK surgery.

Method: We performed a prospective and observational study on 75 patients (150 eyes) undergoing LASIK surgery, who met inclusion criteria. All the patient were categorized on basis of degrees of myopia and all went under same preoperative and postoperative treatment and data was collected using performa. Additionally, axial length of all the cases was measured before and after LASIK, also same techniques were used to measure corneal parameters postoperatively. All the collected data were used to see the change in IOL power before and after LASIK.

Conclusion: IOL power after LASIK surgery changes significantly due to changes occurring at the level of cornea. Higher the degrees of myopia more the difference in IOL power was be seen. The mean increase change in IOL power among 150 eyes using SRK I was 2.95 D ± 1.20, while in SRK II, SRK T, Hoffer Q, Holladay and Binkhorst was 3.03 D ± 1.41, 3.45 D ± 1.45, 4.73 D ± 1.91, 3.91 D ± 1.55 and 4.57 D ± 1.80 respectively. Over all maximum change was seen in Hoffer Q and minimum change in SRK I formula. All the formulae mentioned may produce residual refractive errors, for that the patient has to undergo cataract surgery, but we have only taken the postoperative LASIK patients so it cannot be confirmed which formula yields the least residual refractive error after cataract surgery in post LASIK eyes.

Keywords: Refractive errors, Laser assisted In-situ keratomileusis (LASIK), myopia and intraocular lens power

INTRODUCTION

Uncorrected refractive errors (URE) is defined as a presenting visual acuity of less than 6/12 in the better eye with an improvement of at least 0.2 logMAR (equivalent to two lines) after refraction.(1) Refractive error (RE) is one of the most common ocular conditions affecting all age groups and a priority under the VISION 2020 initiative. Worldwide, uncorrected refractive errors are one the major causes of visual impairment.(2) Around 12.8 million population in age group of 5-15 years were suffering from uncorrected or inadequately corrected refractive errors, which leads to global prevalence of 0.96%.(3)

Among the global population the leading causes for moderate or severe vision impairment (216 million) in 2015 were uncorrected refractive error (116 million), cataract (52.6 million), age‑related macular degeneration (8.4 million), glaucoma (4.0 million), and diabetic retinopathy (2.6 million).(4) Moderate to severe vision impairment which are caused by uncorrected refractive errors is likely to rise by 10% to 128 million, while blindness that is attributable to uncorrected refractive errors is expected to increase by about 8% to 8.0 million by 2020.(4)

The Global Burden of Disease (GBD) Study 2010 suggested that around 101.2 million cases of moderate and severe visual impairment, and 6.8 million cases of blindness were due to uncorrected refractive errors.(5) In Indian population prevalence of myopia is around 34.7%, while hypermetropia with 18.4%(3) Studies conducted at urban India level suggested that 49.3 million of population with age around 15 years may have refractive errors.(6)

Refractive errors like myopia, hypermetropia and astigmatism are the commonest causes of defective vision. Most REs are easily corrected by the help of spectacles at the primary care level. Inspite of the availability of a cost effective intervention, uncorrected refractive error (URE) is a leading public health challenge. Defective visual and blindness which are caused by URE in adults leads to impact severely on their social & economic well‑being, which causes limitation in their educational and employment opportunities of economically active persons.(7)

Among all the REs, myopia is the commonest RE. In myopic eyes, the parallel rays of light coming from infinity tend to focus anterior to the retina, leading to diminution in vision. In myopia the cornea and the lens refract the rays too much for the given axial length or the axial length might be too much for normal refracting optical system. For correction of myopia the commonly used methods include spectacles and contact lens. These methods provide temporary solution for correction. They both have certain functional limitations such as the problems encountered while wearing glasses in rainy season, while playing sports, limited field of vision and chromatic aberration while using higher power. Contact lens also have inconvenience of carrying the solutions, storage containers and might also cause sight threatening corneal infection.(8) There are certain surgical procedures for correcting myopia. These procedures involve an operation over cornea (corneal refractive surgeries) or lens (lenticular refractive surgeries), they work by reducing the focusing power of cornea or lens.

However in recent times there is an emerging trend of correcting refractive errors with surgical procedures like laser assisted in-situ keratomileusis (LASIK) and photorefractive keratectomy (PRK) which are corneal refractive surgeries.(9) Overall, demand for laser refractive surgeries is expected to rise at annual rate of 7.7% from 2009 to 2014 and the number of procedures increasing from 3.4 million to 4.9 million. The majority of growth is occurring in the developing countries of Asia. In India refractive surgeries have also taken pace with 1,28,000 surgeries or more per year.(10)

These procedures cause changes in many aspects of the cornea like corneal curvature, surface, rigidity and thickness in addition to mild changes in axial length of the eye. (11) Refractive surgery is generally done in younger age group. However as the age advances all of these patients will develop cataract and need cataract surgery. Cataract extraction along with intra ocular lens (IOL) implantation is the only way to manage cataracts.

To calculate IOL power for implanting IOL after extraction of cataract, some parameters like keratometery, anterior chamber depth and axial length of the eye ball need to be measured and then IOL power is calculated by using various formulae.(12) Intraocular lens (IOL) implantation after refractive surgery is challenging because standard IOL power formulae leave some significant errors in calculation of IOL power and prevents achievement of postoperative emmetropia.(13)

The aim of the present study is to study the changes occurring in the calculation of IOL power with commonly used formula in patients after corneal refractive surgery.

AIM

- To study the change in IOL power calculation after Laser Assisted in-situ Keratomileusis (LASIK) surgery.

OBJECTIVES

- To study changes in corneal thickness, preoperative and postoperative LASIK surgery.

- To study changes in axial length, pre and post LASIK surgery.

- To study change in corneal keratometry, preoperative and postoperative LASIK surgery.

- To compare various IOL calculation formula results in LASIK surgery cases.

MATERIALS AND METHODS

Study design

- Study was a prospective and observational.

Study period

- The date of approval from ethics committee to 2 years or completion of sample size, whichever is the earliest.

Sample size

- Total number of 75 cases (150 eyes), who are undergoing Laser Assisted In-Situ Keratomileusis (LASIK) surgery.

Study setting

- The entire study was conducted in Ophthalmology department, Dhiraj hospital SBKS Medical Institute and Research Centre, Piparia, Vadodara, Gujarat.

Inclusion criteria

- Age of >18 years to < 40 years
- Refractive power of >-0.5 D to <-8.00 D
- Patients willing to participate
- Patients undergoing only LASIK surgery
- Having stable refraction for atleast one year
- Atleast 1 year of contact lens free period.

Exclusion criteria

- Monocular patients
- Age of <18 years and >40 years
- Patients undergoing refractive surgery other than LASIK
- History of any ocular trauma
- Extended use of contact lens
- History of herpes keratitis
- Severe dry eye or any kind of tear film abnormalities
- Ocular diseases like blephritis, meibomian gland dysfunction, corneal opacities, corneal dystrophies, allergic conjunctivitis etc
- Patients with projected residual corneal stromal bed thickness after ablation is less than 270 microns
- Glaucoma patients
- Keratoconus

- Autoimmune disorders
- Post LASIK corneal ectasia or any kind of post LASIK complications like epithelial ingrowth, keratitis etc
- Patient with posterior segment abnormalities like lattice with or without hole
- Patients not willing for participation
- Patients with unreasonable expectations
- Patient who lost follow ups

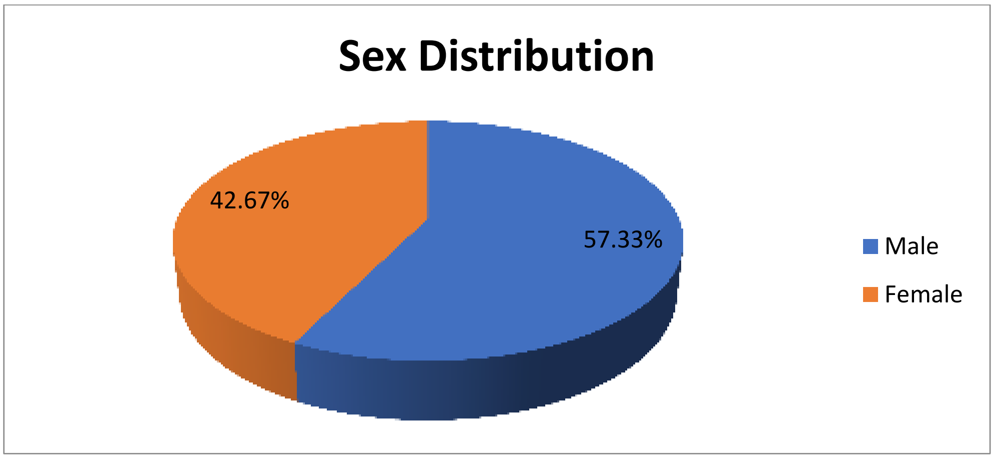
OBSERVATIONS AND RESULTS

This was a clinical, interventional and prospective study held in Department of ophthalmology, Dhiraj hospital, in which we examined 150 eyes of 75 patients. Among them male were 43 (57.33%) and female were 32 (42.67%) as shown in Table 1.

Table 1: Gender wise distribution of patients

Gender	Frequency	Percentage (%)
Male	43	57.33
Female	32	42.67
Total	75	100

Chart 1: Gender wise distribution of patients



The age groups of the patients which are included in are study was divided in 4 groups. Among which 14 (18.67%) patients were <=20 years of age, 34 (45.33%) patients were between 21-25 years, 21 (28%) were in 26-30 years of age group and only 6 (8%) were in >31 years of age group as shown in Table 2 and chart 2. The mean age in male group was 24.67±4.21 and in female group was 24.13±3.40 as shown in Table 3. Thus the mean age was 24.44±3.88 and it was not statistically significant difference between them (p value 0.378).

Table 2: Age wise distribution of patients

Age Group	Frequency	Percentage (%)
<=20	14	18.67
21-25	34	45.33
26-30	21	28.00
>31	6	8
Total	75	100.00

Chart 2: Age wise distribution of patients

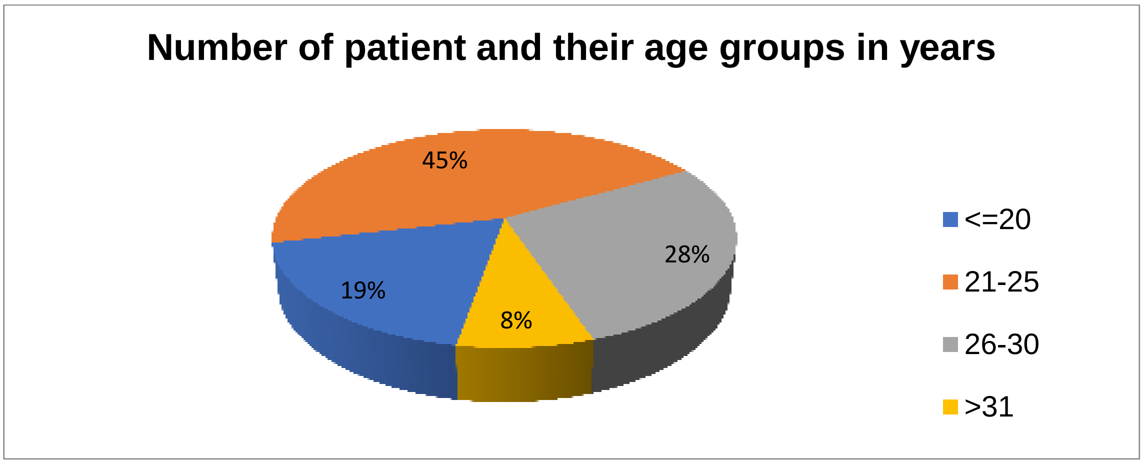
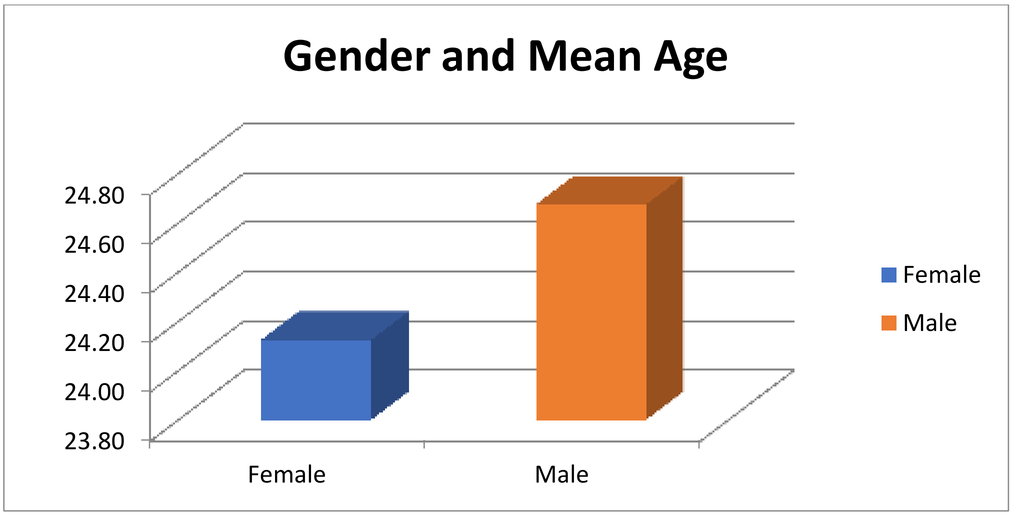


Table 3: Gender and Mean age

Gender	N	Mean	SD	p value
Female	32	24.13	3.40	0.378
Male	43	24.67	4.21	
Total	**75**	**24.44**	**3.88**	

Chart 3: Comparison of gender and mean age



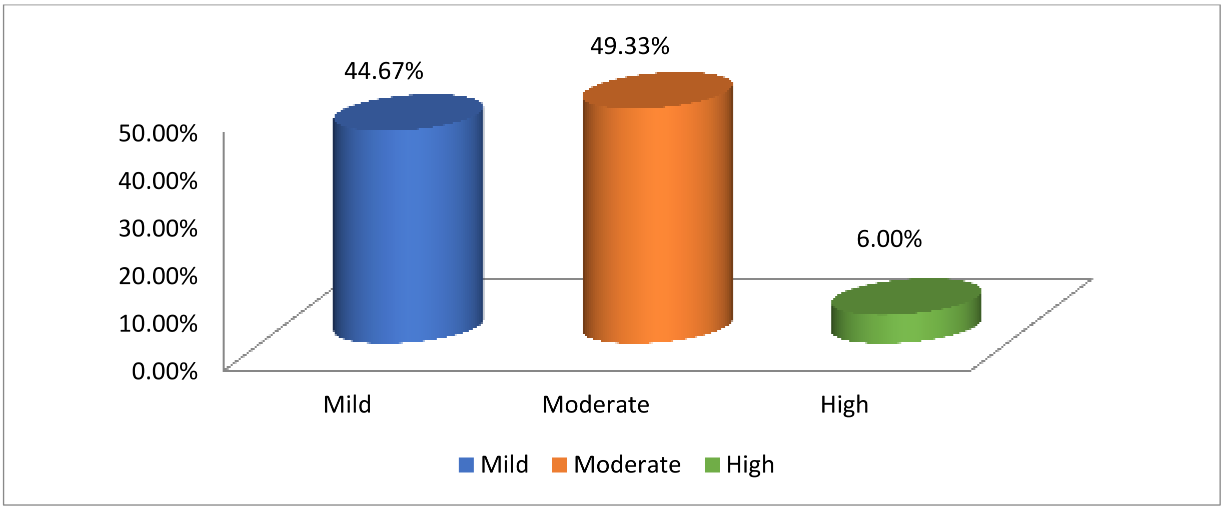
All the eyes taken for our study were differentiated in mild, moderate and high myopia on basis of preoperative refractive errors that is <-3.00 D, -3.00 D to -6.00 D and >-6.00 D respectively.

Table 4: Distribution of mild, moderate and high myopia

Myopia Classification	Number of eyes	%
Mild	67	44.67%
Moderate	74	49.33%
High	9	6.00%
Total	**150**	**100.00%**

Among which 67 (44.67%) eyes had mild myopia, 74 (49.33%) eyes was under moderate myopia and only 9 (6%) eyes had high myopia. Thus the mean myopic population in our study was -3.69±1.56.

Chart 4: Distribution of mild, moderate and high myopia

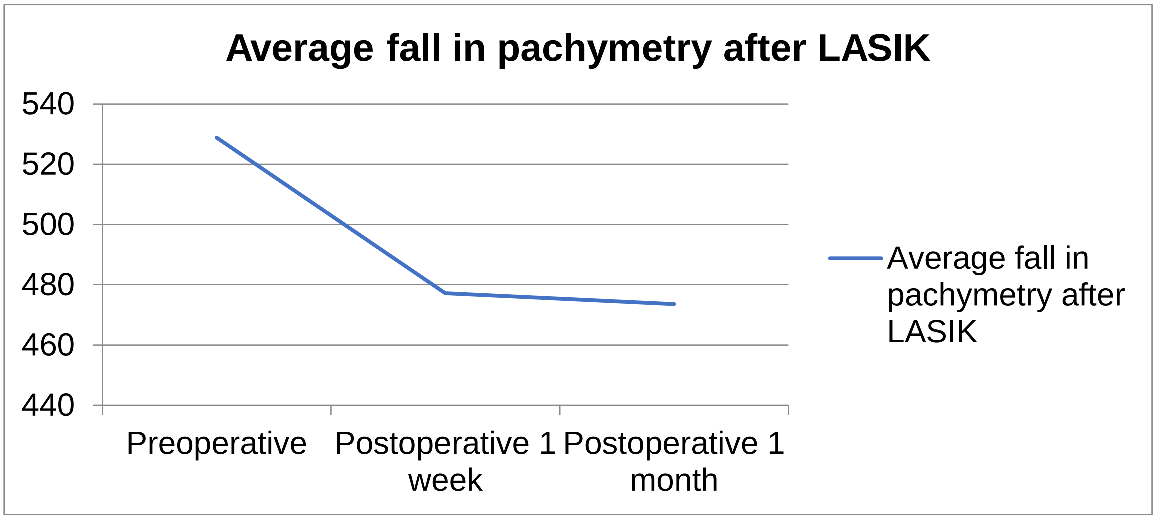


The preoperative mean pachymetry in all 150 eyes was 528.82±32.66, among which mild myopic eyes had mean pachymetry of 525.88±30.43, moderate myopic eyes had 529.26±34.95 and high myopic eyes had 547.11±25.06. There was no significance difference found in different types of myopes and their pachymetry (p value).

Table 5: Preoperative pachymetry in different groups of myopia

Parameter	Myopia Classification	Number of eyes	Mean	Std. Deviation	p value
Preoperative PACHYMERTRY	Mild	67	525.88	30.43	0.185
	Moderate	74	529.26	34.95	
	High	9	547.11	25.06	
	Total	**150**	**528.82**	**32.66**	

Chart 5: Line chart for average pachymetry changes in all postoperative cases



At 1 week follow up, mild myopic eyes had mean pachymetry of 486.70±28.85, moderate myopic eyes had 471.78±39.67 and in high myopic eyes it was 450.44±17.71, thus there was a significant difference in 1st week postoperative pachymetry in different myopic groups (p value 0.002) as shown in Table 6.

Similarly, in 1st month follow up cases, there was significant difference in pachymetry among the different groups of myopia (p value 0.001) as shown in Table 6.

Table 6: Postoperative mean pachymetry in different groups of myopia

Parameter	Myopia Classification	Number of eyes	Mean	Std. Deviation	p value
Post Op 1 week PACHYMETRY	Mild	67	486.70	28.85	**0.002**
	Moderate	74	471.78	39.67	
	High	9	450.44	17.71	
	Total	**150**	**477.17**	**35.42**	
Post op 1 month PACHYMETRY	Mild	67	484.69	28.864	**0.001**
	Moderate	74	466.27	37.994	
	High	9	451.11	19.062	
	Total	**150**	**473.59**	**34.761**	

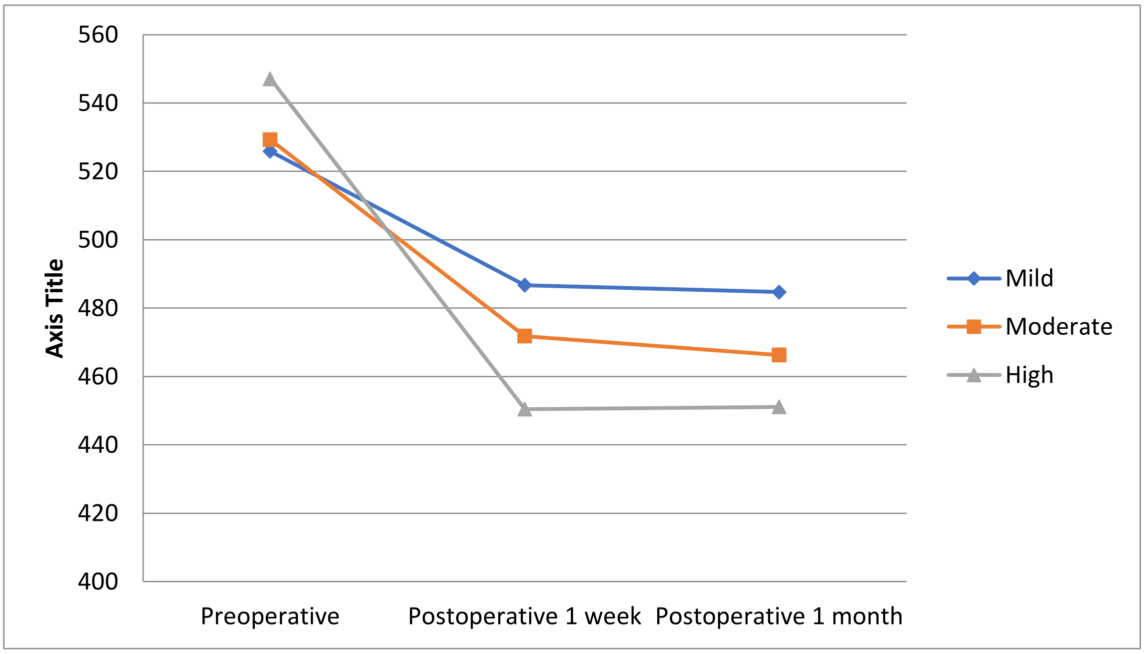
As shown in Table 7, for mild myopia preoperative mean pachymetry was 525.88±30.43 μm which reduced to mean pachymetry 486.70±28.85 μm and 484.69±28.86 μm at 1 week and 1 month respectively. Average reduction of pachymetry in mild myopic eyes was 41.19±12.02 μm. For moderate myopia preoperative mean pachymetry was 529.26±34.95 μm, at 1 week and 1 month postoperative reduction in mean pachymetry was 471.78±39.67 μm and 466.27±37.99 μm respectively. Average reduction of pachymetry in moderate myopic eyes was 62.99±21.50 μm. In high myopia preoperative mean pachymetry was 547.11±25.06 μm which reduced to 450.44±17.71 μm and 451.11±19.06 μm at 1 week and 1 month respectively. There was significant difference between the preoperative and postoperative mean pachymetry but there was no significant difference between 1 week and 1 month

postoperative. Average reduction of pachymetry in high myopic eyes was 96.67±19.87 which is higher than the other myopic groups.
In our study the mean average reduction of pachymetry was 55.23±22.79 after LASIK. Thus, reduction in mean pachymetry was significantly higher with increase in amount of myopia.

Table 7: Comparison of Preoperative and Postoperative pachymetry changes in different groups of myopia

	Mild		**Moderate**		**High**	
PACHYMETRY	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**
Preoperative	525.88	30.43	529.26	34.95	547.11	25.06
Postoperative 1 week	486.70	28.85	471.78	39.67	450.44	17.71
Postoperative 1 month	484.69	28.86	466.27	37.99	451.11	19.06
p value	0.001		0.001		0.001	

Chart 6: Line chart showing difference of pachymetry changes among mild, moderate and high myopia



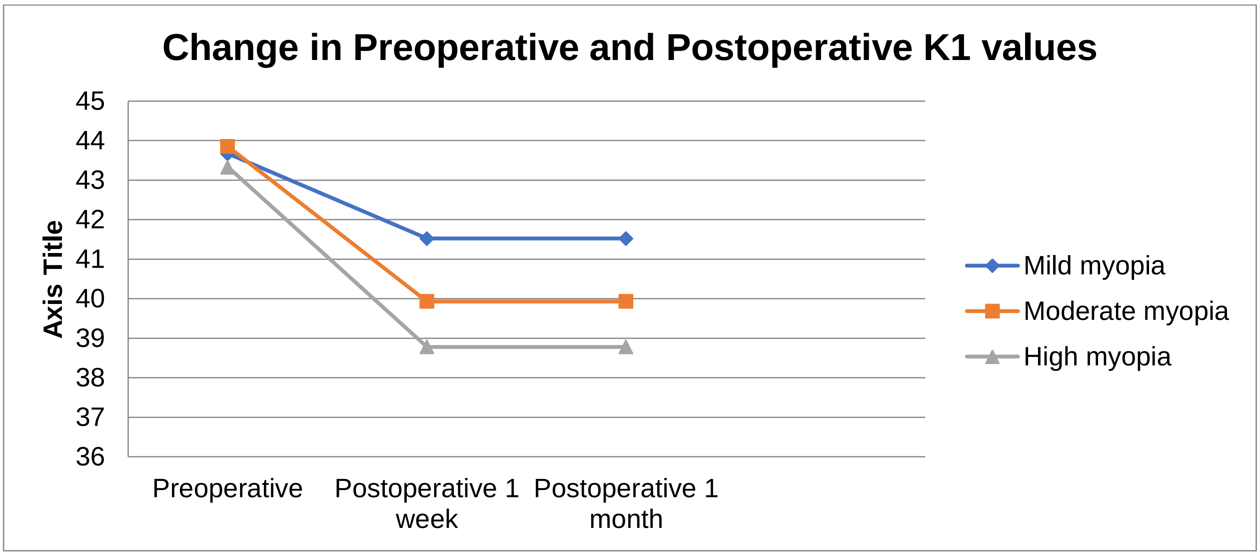
As shown in Table 8, preoperative mean K1 value for mild myopia was 43.67D ±1.39 which changed to 41.52 D ±1.31 and remained constant at 1 week and 1 month postoperative respectively. In moderate myopic cases, mean K1 was 43.85 D ±1.28 preoperatively, which was reduced to 39.93 D ±1.63 and was constant at 1 week and 1 month. In high myopic cases, preoperative mean K1 was 43.33 D ±1.41 and reduced to 38.78 D ±1.09 which was constant on follow-ups. Thus there was significant difference in preoperative and postoperative K1 values after LASIK surgery in all groups (p value 0.001).

The average reduction of K1 in all our cases after LASIK was 3.19 D ±1.32, while average reduction of K1 value was 2.18 D ±0.58, 3.92 D ±1.17 and 4.61 D ±1.11 in mild myopic eyes, moderate myopic and high myopic eyes respectively. We can note that there was more reduction in K1 values (flattening) after LASIK surgery with higher degree of myopia.

Table 8: Comparison between preoperative and postoperative K1 (Flat Keratometry) in different groups of myopia

	Mild		Moderate		High	
K1 Diopters	**Mean**	**Std. deviation**	**Mean**	**Std. deviation**	**Mean**	**Std. deviation**
Preoperative	43.67	1.39	43.85	1.28	43.33	1.41
Postoperative 1 week	41.52	1.31	39.93	1.63	38.78	1.09
Postoperative 1 month	41.52	1.31	39.93	1.63	38.78	1.09
p value	0.001		0.001		0.001	

Chart 7: Linear graph showing reduction in K2 values after LASIK surgery



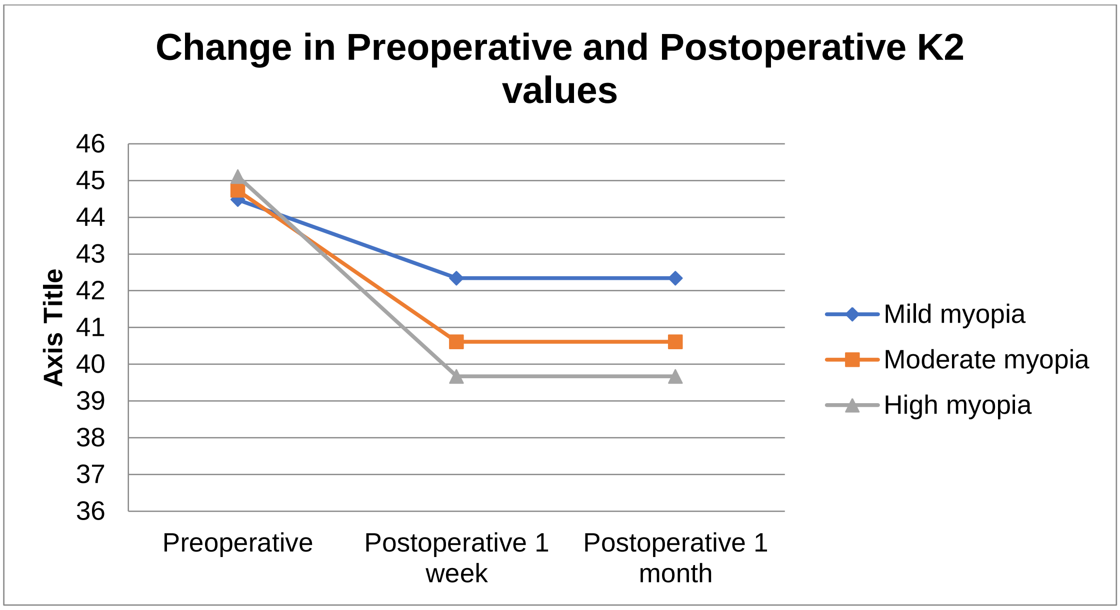
As shown in Table 9, preoperative mean K2 value for mild myopia was 44.48 D ±1.248 which changed to 42.34 D ±1.32 and remained constant at 1 week and 1 month postoperative respectively. In moderate myopic cases, mean K2 was 44.73 D ±1.20 preoperatively, which was reduced to 40.61 D ±1.60 and was constant at 1 week and 1 month. In high myopic cases, preoperative mean K2 was 45.11 D ±1.69 and reduced to 39.67 D ±1.41 which was constant during follow-ups. Thus there was significant difference in preoperative and postoperative K2 values after LASIK surgery in all groups (p value 0.001).

The average reduction of K2 value in all our case after LASIK was 3.33 D ±1.35 and average reduction in mean K2 value in mild myopic eyes, moderate myopic and high myopic eyes was 2.24 D ±0.51, 4.05 D ±1.10 and 5.51 D ±0.76 respectively. We can note that there was more reduction in K2 values (flattening) after LASIK surgery with higher degree of myopia.

Table 9: Preoperative and postoperative K2 (steep keratometry) in different groups of myopia

	Mild		**Moderate**		**High**	
K2 Diopter (D)	**Mean**	**Std. deviation**	**Mean**	**Std. deviation**	**Mean**	**Std. deviation**
Preoperative K2	44.48	1.25	44.73	1.20	45.11	1.69
Postoperative 1 week K2	42.34	1.32	40.61	1.60	39.67	1.41
Postoperative 1 week K2	42.34	1.32	40.61	1.60	39.67	1.41
p value	0.001		0.001		0.001	

Chart 8: Linear graph showing reduction in K2 values after LASIK surgery



In our study of 150 eyes the mean axial length was 24.04 mm ± 0.87 (range of 22mm to 26 mm) in mean myopia of -3.69 D ± 1.57.

Table 10: Comparison of axial length (mm) in preoperative and postoperative cases

	Preoperative	Postoperative	Mean reduction	p value
Mild	23.40 ± 0.58	23.40 ± 0.58	0.017 ± 0.015	0.921
Moderate	24.49 ± 0.74	24.47 ± 0.76	0.011 ± 0.119	
High	24.89 ± 0.33	24.89 ± 0.33	0.016 ± 0.007	
Mean average	24.04 ± 0.871	24.02 ± 0.87	0.014 ± 0.085	

The mean reduction of axial length in mild, moderate and high myopic was 0.017 mm ± 0.015, 0.011 mm ± 0.119 and 0.016 mm ± 0.007 respectively. The mean average reduction was 0.014 mm ± 0.085 which was not significant (p value 0.921).

Table 11: Preoperative mean IOL power (D)

	Mild	Moderate	High
SRK I	19.88 ± 1.77	17.01 ± 1.79	15.22 ± 0.97
SRK II	20.03 ± 1.83	16.84 ± 2.06	15.33 ± 1.00
SRK T	19.94 ± 2.02	16.49 ± 2.20	14.67 ± 1.50
HOFFER Q	19.96 ± 2.57	16.19 ± 2.58	14.11 ± 1.69
HOLLADAY	19.91 ± 2.26	16.47 ± 2.29	14.67 ± 1.50
BINKHORST	19.96 ± 2.69	15.86 ± 2.78	13.78 ± 1.48
p value	0.098	0.05	0.05

Table 11 shows the mean intraocular lens power (IOL) of preoperative patients in various degrees of myopia using various formulae. There was no significant difference between various formulae in mild myopic cases (p value 0.098). While there was some significant difference found in moderate and high myopia (p value 0.05 & 0.05 respectively).

Table 12: Postoperative mean IOL power (D)

Formulae	Mild	Moderate	High
SRK I	21.94 ± 1.80	20.65 ± 1.70	20.0 ± 1.23
SRK II	22.07 ± 1.79	20.65 ± 2.04	19.44 ± 1.33
SRK T	22.25 ± 1.88	20.84 ± 1.87	19.78 ± 1.48
HOFFER Q	23.19 ± 2.46	21.91 ± 2.23	21.56 ± 1.59
HOLLADAY	22.63 ± 2.07	21.27 ± 2.02	20.67 ± 1.41
BINKHORST	23.22 ± 2.55	21.41 ± 2.35	20.67 ± 1.73
p value	0.001	0.001	0.001

As shown in Table 12, after LASIK surgery there was variation in IOL power within different formulae of same group. IOL power in mild myopic cases after LASIK was 21.94 D ± 1.80, 22.07 D ± 1.79, 22.25 D ± 1.88, 23.19 D ± 2.46, 22.63 D ± 2.07 and 23.22 ± 2.55 in SRK I, SRK II, SRK T, Hoffer Q, Holladay and Binkhorst formula. The same was applicable in moderate and high groups. In postoperative cases there was significant difference among all the formulae in all the groups. (p value 0.001) (Table 12)

Chart 9: Line graph of postoperative mean IOL power

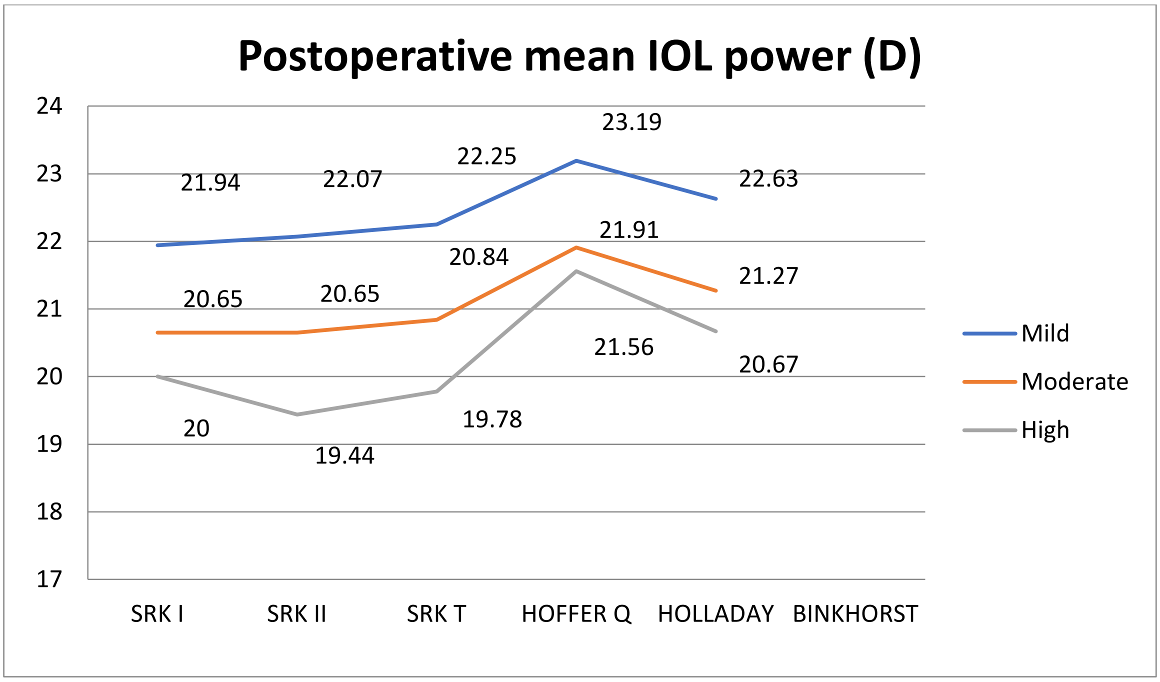
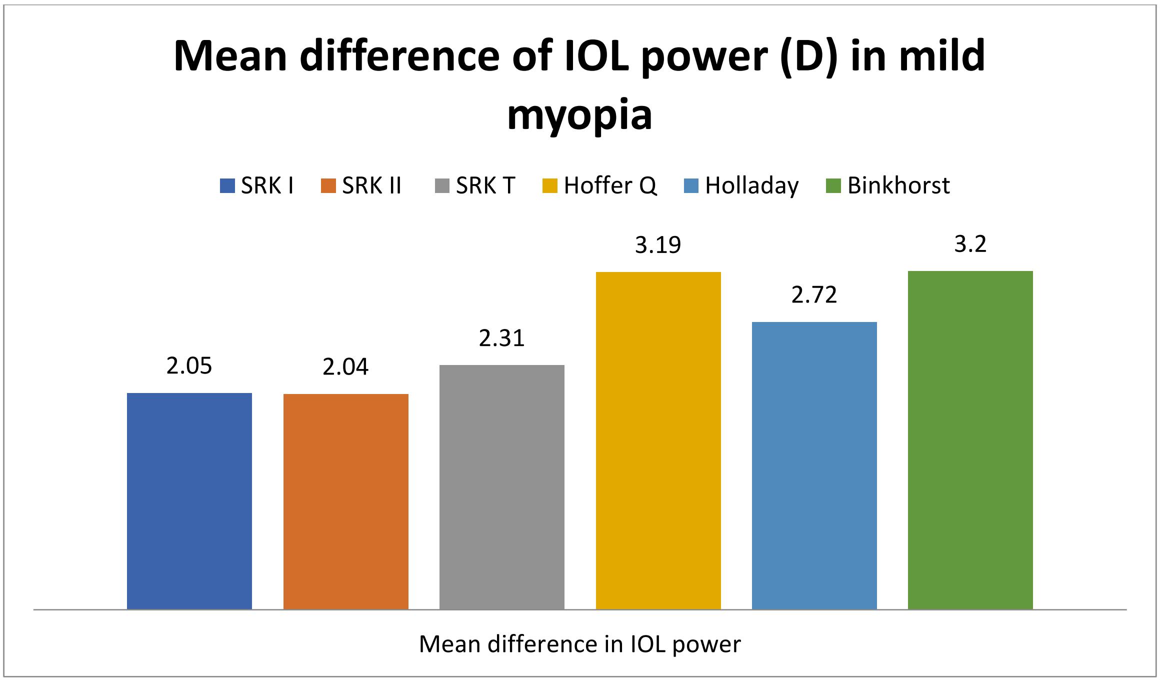


Table 13: Comparison of mean IOL power (D) before and after LASIK in Mild myopic eyes

	Preoperative	Postoperative	Mean increase in power of IOL	p value
SRK I	19.88 ± 1.77	21.94 ± 1.80	2.05 ± 0.52	0.001
SRK II	20.03 ± 1.83	22.07 ± 1.79	2.04 ± 0.46	0.001
SRK T	19.94 ± 2.02	22.25 ± 1.88	2.31 ± 0.54	0.001
HOFFER Q	19.96 ± 2.57	23.19 ± 2.46	3.19 ± 0.67	0.001
HOLLADAY	19.91 ± 2.26	22.63 ± 2.07	2.72 ± 0.60	0.001
BINKHORST	19.96 ± 2.69	23.22 ± 2.55	3.20 ± 0.86	0.001

Chart 10: Bar graph showing the mean difference of IOL power in mild myopia using different formulae



In mild myopic eyes preoperative IOL power using SRK I formula was 19.88 D ± 1.77 and postoperative it was 21.94 D ± 1.80. So the mean difference of IOL power using SRK I formula 2.05 D ± 0.52. The change was significant (p value 0.001). Similarly, the mean difference of diopters in SRK II, SRK T, Hoffer Q, Holladay and Binkhorst was 2.04 D ± 0.46, 2.31 D ± 0.54, 3.19 D ± 0.67, 2.72 D ± 0.60 and 3.20 D ± 0.86 respectively, which proved to be significant. (Table 13) Maximum difference was seen in Binkhorst formula for mild myopic cases, while minimum difference was seen in SRK II (Chart 11)

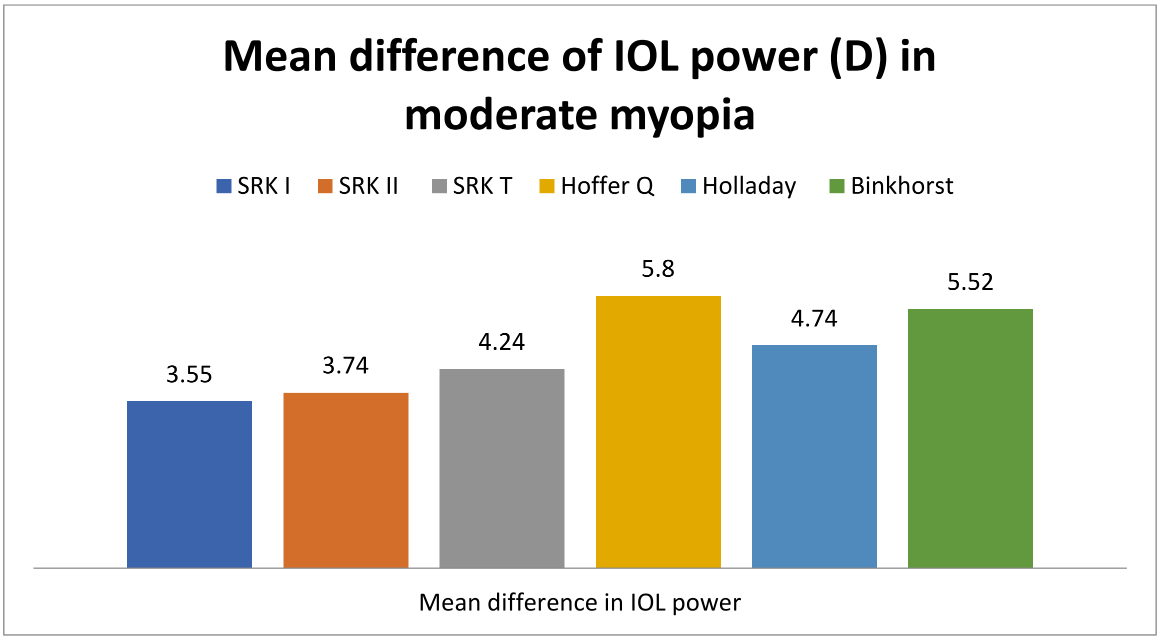
In moderate myopic cases the mean preoperative IOL power was 17.01 D ± 1.79, 16.84 ± 2.06, 16.49 ± 2.20, 16.19 ± 2.58, 16.47 ± 2.29 and 15.86 ± 2.78 using SRK I, SRK II, SRK T, Hoffer Q, Holladay and Binkhorst, while postoperative IOL power using the same formulae was 20.65 D ± 1.70, 20.65 D ± 2.04, 20.84 D ± 1.87, 21.91 D ± 2.23, 21.27 D ± 2.02 and 21.41 D ± 2.35 respectively. This resulted in mean difference of 3.55 D ± 1.07, 3.74 D ± 1.44, 4.24 D ± 1.27, 5.80 D ± 1.64, 4.74 D ±1.38 and 5.52 D ± 1.60 respectively in moderate myopic eyes. (Table 14)

Table 14: Comparison of IOL power (D) before and after LASIK in Moderate myopic eyes

	Preoperative	**Postoperative**	**Mean difference**	**p value**
SRK I	17.01 ± 1.79	20.65 ± 1.70	3.55 ± 1.07	0.001
SRK II	16.84 ± 2.06	20.65 ± 2.04	3.74 ± 1.44	0.001
SRK T	16.49 ± 2.20	20.84 ± 1.87	4.24 ± 1.27	0.001
HOFFER Q	16.19 ± 2.58	21.91 ± 2.23	5.80 ± 1.64	0.001
HOLLADAY	16.47 ± 2.29	21.27 ± 2.02	4.74 ± 1.38	0.001

BINKHORST	15.86 ± 2.78	21.41 ± 2.35	5.52 ± 1.60	0.001

Chart 11: Bar graph showing mean difference of IOL power in moderate myopic eyes

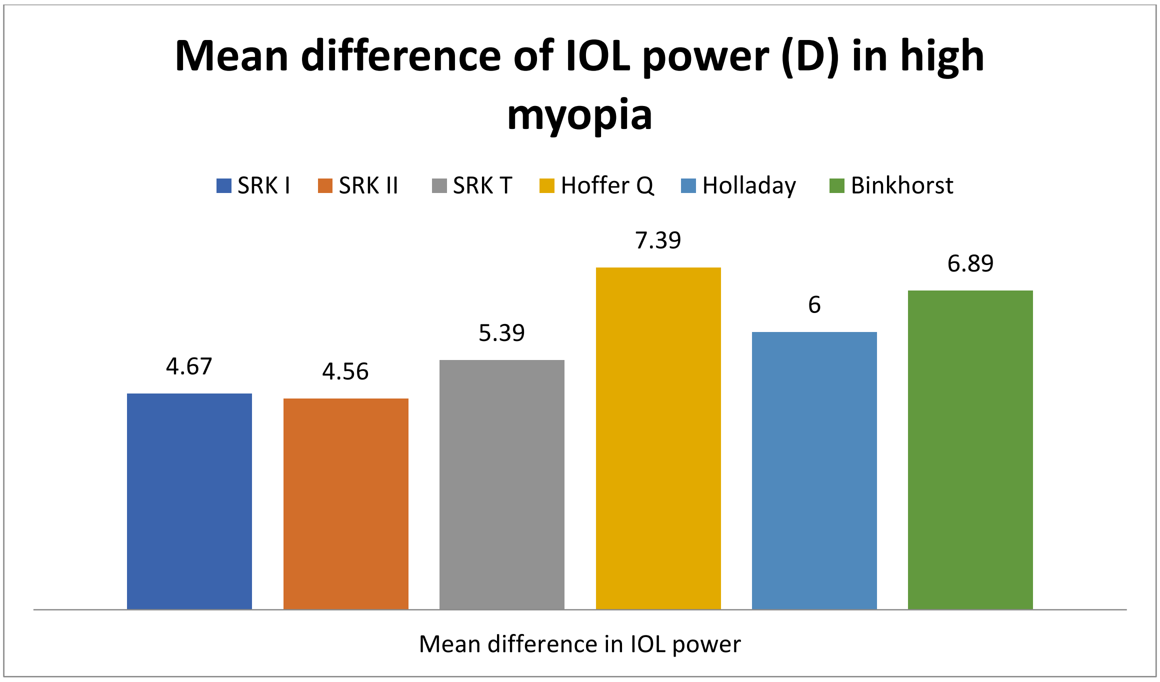


The Chart 12 shows that the maximum difference of IOL power after LASIK was seen in Hoffer Q formula while minimum difference was seen in SRK I among the moderate myopic eyes.

Table 15: Comparison of mean IOL power (D) before and after LASIK in High myopic eyes

	Preoperative	Postoperative	Mean difference	p value
SRK I	15.22 ± 0.97	20 ± 1.23	4.67 ± 0.79	0.001
SRK II	15.33 ± 1.00	19.44 ± 1.33	4.56 ± 0.73	0.001
SRK T	14.67 ± 1.50	19.78 ± 1.48	5.39 ± 1.05	0.001
HOFFER Q	14.11 ± 1.69	21.56 ± 1.59	7.39 ± 1.14	0.001
HOLLADAY	14.67 ± 1.50	20.67 ± 1.41	6.00 ± 1.15	0.001
BINKHORST	13.78 ± 1.48	20.67 ± 1.73	6.89 ± 1.02	0.001

Chart 12: Bar graph showing mean difference of IOL power in high myopic eyes



Similarly in Table 15, in high myopic cases, the mean difference of IOL power after LASIK was 4.67 D ± 0.79, 4.56 D ± 0.73, 5.39 D ± 1.05, 7.39 D ± 1.14, 6.00 D ± 1.15 and 6.89 ± 1.02 respectively using the same formulae. There was significant difference in IOL power after LASIK surgery. The difference between the preoperative and postoperative IOL power was seen more in eyes with high diopters of myopia. Maximum difference of IOL power was seen in Hoffer Q while minimum was seen in SRK II formula in high myopic eyes.

DISCUSSION

This study was performed on 150 eyes of 75 patients over period of one and half year. It included patients with myopia in range of >-0.50 D to <-8.00 D. No consensus on the upper limit of myopia has been established yet, while some studies recommend myopia LASIK <-12.00 D.(14)

In our study, we took 150 eyes of 75 patients, among which there were 43 (57.33%) males and 32 (42.67%) were females (Table 1), thus there was mild preponderance of male over female patients, but it was not significant.

The age group of the patients which were enrolled in our study was divided into 4 groups, <=20, 20-25, 26-30 and >31 years of age. Among which 14 (18.67%), 34 (45.33%), 21 (28%) and 6 (8%) number of patients fell under the above mention groups respectively (Table 2). The mean age in male group was 24.67±4.21 and in female group was 24.13±3.40 (Table 3). Kato N et al(15) reported myopic LASIK surgery on 779 eyes with mean age of 34.6±8.3 years. Yuen LH et al(16) performed LASIK surgery in 37,932 eyes with mean age of 33 ± 7.9 years. The average age of the patients in other studies were significantly higher compared to our study. Difference of opinion does exist regarding the upper limit of age, while most of the authors agreed that LASIK is not to be performed below age of 18 years.

All the similar studies have consensus regarding rest of the patient selection criteria like, refractive status should be stable for at-least 1 year before undergoing LASIK, lens has to be clear, and patient should understand that this procedure will not prevent presbyopia and cataract formation from developing in future.

In our study, all the eyes undergoing LASIK were differentiated in mild, moderate and high myopia on basis of preoperative refractive errors, is <-3.00 Diopters (D), -3.00 D to -6.00 D and >-6.00 D respectively. Among which 67 (44.67%) eyes had mild myopia, 74 (49.33%) eyes was under moderate myopia and only 9 (6%) eyes had high myopia. Thus the mean diopters myopia was -3.69 D ± 1.57. Kato et al underwent LASIK surgery with the mean diopters of myopia as -6.40 D ± 2.58, which was much higher than our study.

In our study, the mean pachymetry preoperatively was 528.82 μm ± 32.66, which after surgery reduced to 477.17 μm ± 35.42 in 1st week follow-ups and 473.59 μm ± 34.76 on 1st month follow up (Table 6) and the average reduction of pachymetry after surgery was 55.23 μm ± 22.79 in average myopia of -3.69 D ± 1.57. Therefore, there is significant change in pachymetry after refractive surgery. A study conducted by Zhao et al(17) stated, mean preoperative pachymetry in 302 eyes was 531.6 μm ±24.3 and on postoperative 1 month follow-up it was 427.2 μm ± 38.0 which was also found significant and the average reduction was 4.06 μm ± 9.99. The data of this study relates favorably with our results. Therefore significant decrease in pachymetry after LASIK is due to ablation of corneal stroma, which will be permanent rest of the life.

In our study, we also mentioned the relative difference in changes of pachymetry among various types of myopia. In mild myopic eyes, the average reduction of pachymetry was 38.84 μm ± 13.39, while in moderate and high myopic eyes were 57.47 μm ± 22.78 and 96.67 μm ± 19.87 respectively. Thus, reduction in mean pachymetry was significantly higher with increase in amount of myopia, because deeper ablation is required for higher correction than lower diopters of myopia (Chart 7). Therefore, the residual thickness will be lower in high myopia comparative to moderate or mild myopia.

In our study the mean K1 and K2 value for mild myopic cases was 43.67 D ±1.39 and 44.48±1.25 respectively, which reduced to 41.52 D ±1.31 and 42.34±1.32 at 1st week and 1st month follow-up and remained constant after 1st week. Average reduction noted in K1 and K2 value after LASIK for mild myopia was 2.18 D ± 0.58 and 2.24 D ± 0.51 for moderate myopia was 3.93 D ± 1.17 and 4.05 D ± 1.10. While in Maldonado Bas A(18) study preoperative keratometry was 44.09 D ±1.65 which changed to 39.11 D ±1.61 with average reduction of 4.98 D ±0.4 for myopia up-to -5.00 D which was greater reduction in K values than in our study. This less reduction would have been due to use of newer generation of laser excimer machine which was used in our study and it can also be due to different type of flap repositioning technique.

In present study the preoperative mean K1 and K2 values were 43.33 D ± 1.41 and 45.11 D ±1.69 which reduced to 38.78 D ±1.09 and 39.67 D ±1.41 respectively, which was constant on 1st week and 1st month follow-ups. The mean reduction K1 and K2 values was 4.61 D ± 1.11 and 5.51 D ± 0.76, while in Maldonado Bas A(18) study average K value reduction was 6.78 D ±0.8 and 8.18 D ±0.5 was observed in myopia of -5.00 to -10.00 D and -10.00 to -15.00 D. Reduction in this study was more than observed in our study.

The topographic stability were achieved after 6 month follow-up in Maldonado Bas A(50) this observed delay in achieving stability could be due to increased amount of attempted correction. It is known that after higher attempted myopic corrections, it takes longer for topography to stabilize than after smaller correction.(19,20) This is in contrast to our study as there was no significant change keratometry values after 1 week follow-up to 1 month follow-up.

The mean preoperative axial length in our 150 eyes was 24.04 mm ± 0.87 (range of 22mm to 26 mm) in mean myopia of -3.69 D ± 1.57. In a study conducted by Rosa N et al the axial eye length measurements ranged from 22.51 to 31.32 mm and the mean was 25.61 mm ±1.47 before PRK. Mohrenfels C et al, observed the mean axial length prior to LASEK was 25.46 mm ± 1.03 which had a range of 23.39 to 27.09 mm

The postoperative mean axial length in our study was 24.02 mm ± 0.87. We observed mean reduction in axial length after LASIK as 0.017 mm ± 0.015, 0.011 mm ± 0.119 and 0.016 mm ± 0.007 in mild, moderate and high myopic eyes respectively and the mean average reduction was 0.014 mm ± 0.085 with p value of 0.921. Rosa et al observed the mean axial length of 25.48 mm ±1.43 (22.39 to 31.10 mm) 1 month after PRK. In this study preoperative and 1st month postoperative data showed a statistically significant difference (P<.001).(21)

Study conducted by Mohrenfels C et al, observed the mean axial length one month after LASEK was 25.38 mm ± 0.99, indicating that there were no significant difference between pre-operative and postoperative values(22).

Our study had contrasting results than the Rosa et al, while Mohrenfels C et al study showed similar observations like our study, which didn't had any significant changes in axial length after the surgery, the only difference was type of surgery performed, which was LASEK in Mohrenfels C study while we performed LASIK.

There will be a minimum change in axial length as the surgery is performed on the anterior corneal surface. The change in axial length can be due to errors occurred during the measurement of axial length using the contact ultrasonic A scan.

In our study of 150 eyes we found no significant difference in IOL power calculated by various formulae in preoperative mild myopic cases (p 0.098), but there was some significant difference between the formulae used in moderate and high myopic cases.

In our study, mild myopic eyes had IOL power of 19.96 D ± 2.69 preoperative and postoperative it was 23.22 D ± 2.55 using Binkhorst formula. The resulted mean difference was 3.20 D ± 0.86 which was maximum among all the formulae in mild myopic group. The change was significant (p value 0.001). Similarly, the mean difference of diopters in SRK I, SRK II, SRK T, Hoffer Q and Holladay was 2.05 D ± 0.52, 2.04 D ± 0.46, 2.31 D ± 0.54, 3.19 D ± 0.67 and 2.72 D ± 0.60 respectively, which proved to be significant. (Table 13) Minimum difference was seen in SRK II (2.04 D ± 0.46).

In moderate myopic cases the resulted mean difference between the IOL power before and after surgery was 3.55 D ± 1.07, 3.74 D ± 1.44, 4.24 D ± 1.27, 5.80 D ± 1.64, 4.74 D ±1.38 and 5.52 D ± 1.60 respectively using SRK I, SRK II, SRK T, Hoffer Q, Holladay and Binkhorst. (Table 14) The maximum difference was seen in Hoffer Q formula (5.80 D ± 1.64) while minimum was SRK I (3.55 D ± 1.07).

Similarly, in high myopic cases, the mean difference of IOL power after LASIK was 7.39 D ± 1.14 using Hoffer Q. The mean difference of IOL power was seen maximum in Hoffer Q and minimum in SRK II (4.56 D ± 0.73) among the other formulae.

The mean change in IOL power among 150 eyes using SRK I was 2.95 D ± 1.20, while in SRK II, SRK T, Hoffer Q, Holladay and Binkhorst was 3.03 D ± 1.41, 3.45 D ± 1.45, 4.73 D

± 1.91, 3.91 D ± 1.55 and 4.57 D ± 1.80 respectively. Maximum change was seen in Hoffer Q and minimum change in SRK I formula.

There was significant difference in IOL power after LASIK surgery. The difference between the preoperative and postoperative IOL power was seen more in eyes with high diopters of myopia.

We were not able to compare various different studies with our study as we were not able to find studies comparing various formulae before and after LASIK surgery. Our study was first to study change in IOL power before and after LASIK surgery so more research is yet to be done on this topic.

There are considerable limitations of our study, among which one of the major limitation was none of our patient studied underwent actual cataract surgery. As the IOL power to be implanted can be better be judged after cataract surgery as post surgery residual errors gives surprising results. LASIK surgery changes the anterior curvature of the cornea only; posterior curvature remains the same even after the surgery. We use corneal topograph to measure the keratometric values after LASIK surgery. Corneal topography measure the anterior curvature by taking normal anterior posterior curvature ratio (7.8mm/6.7mm). This ratio is altered after the LASIK surgery thus the keratometric values measured on the manual keratometry and topograph were overestimated than the actual true power of cornea. To find out the actual true power of cornea we require different formulae. This was the second most important area which was lacking in our study.

For better understanding the IOL power after LASIK surgery more research work has to be carried out with higher number of patients as a subject.

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