ORIGINAL ARTICLE

Minimum to nil post cataract astigmatism by clear corneal incisions on the steep meridian

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Abstract

Background: Blurred vision, monocular diplopia, glare sensation, visual aberrations and asthenopia may cause by astigmatism. The rectification of astigmatism is one of the main aims of modern cataract surgery.

Objective: The main objective of current study is to achieve minimum to nil post cataract astigmatism by giving clear corneal incisions on the steep meridian

Material and Methods: A cross-sectional study was carried out among 221 consecutive eyes, 221 patients, visited Department of Ophthalmology, Liaquat National Hospital Karachi from 23rd March 2018 to 22nd September 2018. Pre-operative visual acuity documented by auto refractometer and snellen chart. Keratometric reading, axial length and intraocular lens power calculation was done by IOL master. Each patient steep axis will be noted prior to surgery and clear corneal incision with 3.2mm knife will be given on the steep axis, which in turn flattens it, thereby reducing or eliminating the astigmatism. Post-op the patients will be seen on 1st day, 1st week and 3rd week and on each follow up their visual acuity and refraction will be noted and compared with pre-op astigmatism. Data was analyzed by using SPSS-21. Normality was checked by Shapiro wilk test. Friedman test and Wilcoxon Signed Ranks test were applied to compare means at 1st day, 1st week and 3rd week as appropriate.

Results: Out of 221 patients, 123 were male and 98 were female. The mean age of patients was 58.00±4.54 years. Mean K1, K2, AXL and IOL was 43.95±1.95, 43.93±1.91, 23.33±1.31 and 20.83±3.41 respectively. Spherical refraction was 0.11±1.01, 0.02±0.70 and 0.01±0.37 at 1st day, 1st week and 3rd week respectively while cylindrical refraction was -0.633±0.96,-0.42±0.56, -0.29±0.39 at 1st day, 1st week and 3rd week respectively. Among 221 patients, 6/6 visual acuity was achieved in 88.7% of patients. We found significant mean spherical refraction difference at 1st day, 1st week and 3rd week as well as significant mean cylindrical difference. No significant mean difference was found for 1st week refraction with pre-op-refraction while there was significant mean difference with 3rd week refraction.

Conclusion: The utilization of clear corneal incisions of 3.2 mm on steep axis during the routine procedure of phacoemulsification can help in the rectification of mild to moderate pre-existing astigmatism carrying the advantage of using no additional instruments and also having no requirement of any change in the surgical procedure.

Keywords: astigmatism, clear corneal incisions, cataract surgery

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Introduction:

Blurred vision, monocular diplopia, glare sensation, visual aberrations and asthenopia may cause by astigmatism.[1] The correction of astigmatism has become one of the main aims in modern cataract surgery with the use of smaller incisions and foldable intraocular lenses (IOLs) during surgery. Cataract operation presents the ideal opportunity to reduce or eliminate mild to moderate corneal astigmatism in routine patients.[6] One of the main purposes of phacoemulsification is to control and also to a certain extent

Table 1: *Descriptive statistics of study Population*

		n(%)	Range
Gender	Male	123(55.7)	
	Female	98(44.3)	
Eye	Right	105(47.5)	
	Left	116(52.5)	
Age (years)°		58.00±4.54	44 to 72
K1°		43.95±1.95	39.60 to 47.68
K2°		43.93±1.91	39.64 to 48
AXL°		23.33±1.31	21 to 27
IOL°		20.83±3.41	6-to 27
Refraction at 1st Day (spherical)°		0.11±1.01	-2 to 3
Refraction at 1st Week (spherical)°		0.02±0.70	-0.5 to 2
Refraction at 3rd Week (spherical)°		0.01±0.37	-0.75 to 1
Refraction at 1st Day (cylindrical)°		-0.633±0.96	-4 to 2
Refraction at 1st Week (cylindrical)°		-0.42±0.56	-2 to 1.50
Refraction at 3rd Week (cylindrical)°		-0.29±0.39	-1 to 0.50
Corrected Visual Acuity	6/6	196(88.7)	
	6/9	25(11.3)	

°*Mean±SD*

Table 2: *Mean comparison of refraction at 1st day, 1st week and 3rd week*

	Mean±SD	P-Value
Refraction at 1st Day (spherical)°	0.11±1.01	
Refraction at 1st Week (spherical)°	0.02±0.70	<0.05
Refraction at 3rd Week (spherical)°	0.01±0.37	
Refraction at 1st Day (cylindrical)°	-0.633±0.96	
Refraction at 1st Week (cylindrical)°	-0.42±0.56	<0.01
Refraction at 3rd Week (cylindrical)°	-0.29±0.39	

Friedman test was applied

Table 3: *Mean comparison of refraction at 3rd week vs 1st week and 1st day*

	P-Value
Refraction at 3rd Week vs. 1st week (spherical)	0.943
Refraction at 3rd Week vs. 1st day (spherical)	0.066
Refraction at 1st Week vs. 1st day (spherical)	<0.01
Refraction at 3rd Week vs. 1st week (cylindrical)	<0.01
Refraction at 3rd Week vs. 1st day (cylindrical)	<0.01
Refraction at 1st Week vs. 1st day (cylindrical)	<0.01

Wilcoxon Signed Ranks test was applied

reduce corneal astigmatism which is found to be prevalent in 14%-50% of the population and seems to change with age.[7-8] Numerous methods are applicable for the procedure which include variations in size and site of the incision. Astigmatism can be treated by applying clear corneal incision (CCI) on the steep axis, implantation of toric IOL, laser in situ keratomileusis (LASIK) and by using corneal relaxing incisions.[1-5]

Approximately half of the population in their sixth decade suffer from an astigmatism of >1.00 diopter (D) while almost 22% of those undergoing the procedure of phacoemulsification had pre-existing astigmatism >1.50 D.[9-12] The process of using clear corneal incision during the cataract surgery has become a standard procedure. The dual goals of decreasing the astigmatism risen during surgery and also that was pre-existing to restore the visual function as quickly as possible can result in excellent surgical outcomes.[13] clear corneal incision is an ideal way of doing so without much additional cost or time. By understanding the refractive effect of clear corneal incision with time, surgeons are able to make this procedure more predictable. It is likely to reduce patient spectacle dependence and provide higher visual satisfaction. We want to reduce astigmatism of mild to moderate nature during phacoemulsification and without any extra charges. The main objective of current study is to achieve minimum to nil post-cataract astigmatism by giving clear corneal incisions on the steep meridian. There is no requirement of additional instruments and it is much cheaper than refractive laser or toric IOL.

Materials and Methods:

A cross-sectional study was carried out among 221 consecutive eyes, 221 patients, visited Department of Ophthalmology, Liaquat National Hospital, Karachi aged ranging between 44 to 72 years of either gender. Sample size was calculated by WHO sample size calculator taking mean =0.58±0.5314, margin of error=7% at 95% CI. Data was collected through proforma from 23rd March 2018 to 22nd September 2018. This study was conducted after approval of hospital ethical review committee. Written and verbal informed consent was taken from the patient. Patients with astigmatism of up to 3-diopters were included in study while patients with no astigmatism, any retinal or macular pathology, keratoconus, and prior eye surgery were excluded from study.

Table 4: *Mean comparison of pre-op-refraction with post-op-refraction at 1st week and refraction at 3rd week*

	Mean±SD	P-Value
Refraction at 1st Week vs. Pre op refraction	0.6276±0.345 vs. 0.681±0.741	0.848
Refraction at 3rd Week vs. Pre op refraction	0.475±0.16 vs. 0.681±0.741	<0.01

Wilcoxon Signed Ranks test was applied

Pre-operative visual acuity documented by auto refractometer and snellen chart. Keratometric reading, axial length and intraocular lens power calculation will be done by IOL master. Each patient steep axis will be noted prior to surgery and clear corneal incision with 3.2mm knife will be given on the steep axis, which in turn flattens it, thereby reducing or eliminating the astigmatism. Post-op the patients will be seen on 1st day, 1st week and 3rd week and on each follow up their visual acuity and refraction will be noted and compared with pre op astigmatism.

Data was analyzed by using statistical package for social sciences (SPSS) version 21. Mean and standard deviation were computed for quantitative variable and frequency and percentage were calculated for qualitative variables. Normality was checked by Shapiro Wilk test. Friedman test and Wilcoxon Signed Ranks test were applied to compare means at 1st day, 1st week and 3rd week as appropriate.$p \leq 0.05$ were considered as significant.

Results:

Total 221 patients of either gender with age ranging between 44 to 72 years were included in the study to achieve minimum to nil post cataract astigmatism by giving clear corneal incision on the steep meridian.

Out of 221 patients, 123 were male and 98 were female. The mean age of patients was 58.00±4.54 years. Mean K1, K2, AXL and IOL was 43.95±1.95, 43.93±1.91, 23.33±1.31 and 20.83±3.41 respectively. Spherical refraction was 0.11±1.01, 0.02±0.70 and 0.01±0.37 at 1st day, 1st week and 3rd week respectively while cylindrical refraction was -0.633±0.96,-0.42±0.56, -0.29±0.39 at 1st day, 1st week and 3rd week respectively. Among 221 patients, 6/6 visual acuity was achieved in 88.7% of patients. Detailed descriptive statistics of study population are presented in table-1.

Normality assumption was violated for our data therefore non parametric tests were used. We found significant mean spherical refraction difference at 1st day, 1st week and 3rd week (p=0.018) as well as significant mean cylindrical difference (p=0.000) as presented in Table-2. Spherical and Cylindrical refraction means were also compared as 3rd week vs 1st week, 3rd Week vs 1st day and 1st Week vs 1st day as presented in Table-3. No significant mean difference was found for 1st week refraction with pre-operative refraction (p=0.848) while there was significant mean difference with 3rd week refraction (p=0.000) as presented in Table-4.

Discussion:

There is increasing demand for the ophthalmic surgeon to perform refractive cataract surgery especially in small incision cataract surgery. The main objective of modern cataract surgery is to achieve desirable refractive outcomes postoperatively. Various factors affecting results, the induction of minimum amount of SIA is known as one of the most vital factor. Many of the patients who undergo the procedure of phacoemulsification as they have the expectations of a clearer vision and reduced usage of spectacles in comparison to the period prior to the surgery. To meet patient's expectations, one important consideration is astigmatism reduction. After cataract surgery astigmatism is one of major reason to optical correction. Several techniques for the correction of pre-existing astigmatism are availablewith the purpose of gaining emmetropia as well as reducing dependence on the eye glasses. Refractive outcome for astigmatism reduction improves by modifications in surgical technique and incisions. During phacoemulsification, with the numerous methods available for the rectification of astigmatism,the utilization of steep clear corneal incision is the easiest way of incision but surgeons could face difficulty with certain axes.

Astigmatism cancorrect with glass, contact lens or surgery in regular pattern and with contact

lens in irregular pattern. Astigmatism correction can be done with flattening in steep meridian.[15,16] Lever et al.,[3] reported that in a study cohort of 33 patients, a 3.5 mm clear cornea incision across the opposite straddling the steep axis managed to decrease the pre-existing astigmatism by a mean value of 2 D while Tadros et al.[17] reported the decrease of 0.5 D and Khokhar[18] reported the decrease to be 1.5 D. Qammar et al.,[19] reported the same decrease of 2.0 D as that of Lever et al. in his study cohort of 15 patients. Studies reported that at 3 mm and 3.5 mm clear corneal incisions across the steep axis can help in the reduction of pre-existing astigmatism.[1,20]

In comparison to other methods, a clear corneal incision on the steep axis is easier from technical point of view as the same 3.2 mm knife used during the procedure of phacoemulsification is the one used for the clear corneal incision and thus also making it economically feasible as no additional cost is incurred. Although, clear corneal incision on the steep axis method is an effective technique for the rectification of corneal astigmatism of mild to moderate severity, but it is recommended that different or a combination of available methods be used in eyes with higher degrees of astigmatism.[21]

In order to minimize the astigmatism, studies shows importance of corneal relaxing incisions.[22] Besides the location and site of the incision, the width of the incision also plays an important role in the causation of post-operative astigmatism.[23] It has been observed that the placement of an incision on the steepest meridian results in substantial flattening in that meridian along with concordant steepening in the opposite meridian. Studies have reported that the use of temporal clear corneal incisions of 2.8, 3.2, and 4.0 mm results in astigmatism of very low value and can be used appropriately in eyes with neutral astigmatism and with low preoperative WTR astigmatism.[24-27]

Conclusion:

The utilization of clear corneal incisions of 3.2 mm on steep axis during the routine procedure of phacoemulsification can help in the rectification of mild to moderate pre-existing astigmatism carrying the advantage of using no additional instruments and also having no requirement of any change in the surgical procedure.

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Role and contribution of authors:

Dr. Abdul Hameed Siddique, Overall management, clinical examination and selection of the patients for cataract surgery. Post-operative follow up, literature search also collected the data, references and did the initial writeup.

Dr. Rabia Ahmed Jalali, pre-operative examination of patients, literature search and writing of manuscript,the software for statistical package, statistical analysis of the data.

Dr. Sahira Wasim, History and clinical examination of patient,Biometry for cataract surgery, and record entry in SPSS,literature search and writing of manuscript.

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