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ORIGINAL ARTICLE

Changes in Corneal Astigmatism after Closing Clear Corneal Incision by Simple Hydration Undergoing Phacoemulsification at the Department of Ophthalmology JPMC

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ABSTRACT

Purpose: To determine the mean changes of corneal astigmatism after closing clear corneal incision by simple hydration undergoing phacoemulsification in the eye department of a tertiary care hospital.

Methodology: This was a Quasi experimental study conducted at the department of Ophthalmology, Jinnah Postgraduate Medical Center, Karachi, from 30th October 2020 to 29th April 2021. Total 100 patients who underwent phacoemulsification surgery for cataract were included. Changes of astigmatism were measured with Auto-refractometer. Fundus examination was done using +90D lens with a slit lamp. Mean changes in corneal astigmatism were calculated. Pre and post operatively change in astigmatism was compared using paired t-test. Stratification was done. P value ≤0.05 was considered as statistically significant.

Results: Mean age was 43.47±11.13 years. There were 54% male and 46% female patients. Mean change of corneal astigmatism was 0.23±0.44 diopter. Mean corneal astigmatism, preoperatively, after 1 week and after 1 month were 1.05±0.05 diopter, 0.69±0.34 diopter and 1.28±0.44 diopter respectively. Highly significant mean difference of corneal astigmatism was observed between preoperatively and after 1 week, preoperatively and after 1 month and also observed between 1 week and 1 month.

Conclusion: Closing clear corneal incision by simple hydration undergoing phacoemulsification was found an effective technique for treatment of corneal astigmatism.

Keywords: Mean Changes, Corneal Astigmatism, Closing Clear Corneal Incision, Simple Hydration, Phacoemulsification

INTRODUCTION

Cataracts are the leading cause of visual impairment and blindness in the world. Prevalence of blindness in the world of 0.7% with 39% cataract causes.[1] Phacoemulsification is the most advanced method of treating cataracts, but sometimes there is no improvement in vision after this procedure because of either surgically induced astigmatism (SIA), or pre-existing astigmatism (PEA). Modern cataract surgery aims to improve visual acuity (VA) as well as reduce preexisting astigmatism (PEA), which may cause decreased VA and poor vision quality. The surgically induced astigmatism (SIA) associated with a 3.2-mm clear corneal phacoemulsification incision is about 0.5D. Perhaps wound stretching during IOL implantation decreases astigmatism with incisions of 2.4 mm.[2,3]

A phacoemulsification incision should be made on the steep meridian of corneal astigmatism in patients with less than 1 D of pre-existing corneal astigmatism. The superotemporal incision is easier for right-handed surgeons to make in the right eye, while the superonasal incision is easier for left-handed surgeons.[4-7] As an individual age, their corneal astigmatism changes from with-the-rule (WTR) to against-the-rule (ATR), which also affects postoperative vision. It is common knowledge that placing clear corneal incisions may cause a flattening at the meridian of incision, followed by a steepening of 90°. ATR (against-the-rule) astigmatism can be reduced, but WTR (with-the-rule) astigmatism may worsen following surgery at the superotemporal meridian of the right eye.[1,8] In contrast, the situation is reversed when surgery is performed on the left eye at the supranasal level. The median preoperative astigmatism score should be 2(95% CL=1-3, range 1 to 12), while the postoperative median score should be 2.5 (95%CL=1-3, range 1 to 11).[9,10] Reading performance and nighttime driving are negatively affected by astigmatism of 1–1.5 D or more. The absence of treatment for astigmatism can cause reduced vision and affect patients' health and quality of life. Because of our experience performing phacoemulsification at the superonasal and superotemporal sites, closing the incisions with simple hydration, and exploring other options to decrease SIA and PEA during surgery, this study is aimed at sharing our experience with dealing with corneal astigmatism. Incisions can be made in that meridian to reduce corneal astigmatism. The purpose of our study was to shrink astigmatism and save vision in patients with astigmatism.

MATERIAL & METHODS

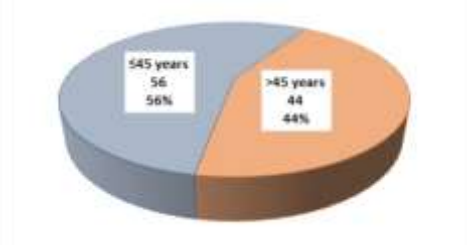
The study was conducted in the Department of Ophthalmology, Jinnah Postgraduate Medical Centre, Karachi, from 30th October 2020 to 29th April 2021. Estimated sample size of my study was 100 patients. By using open Epi calculator sample size calculated taking statistics as follows, Pre-operative mean =1.60 ±0.55 D, Postoperative mean =1.30±0.80 D, Power of test=80% and CL 95%. The calculated sample size came out as above and we included 100 patients. The patients underwent phacoemulsification having either gender, age between 25-65 years, having mature Cataract for minimum duration of 6 months (Assessed on clinical examination) were included in our study. However, patients having Traumatic cataract reporting to Eye department of JPMC. Patients having co-morbidities (e.g.: Glaucoma). (Assessed on medical record and clinical examination), patients having post-operative complications (e.g.: Endophthalmitis, Retinal detachment, Cystoid macular edema), assessed on medical record and clinical examination not included in our study. All patients between 25-65 years of age meeting the inclusion criteria were included. The purpose, procedure, risks and benefits of the study were explained, confidentially of the data and the patients were maintained and informed consent was taken from patients. All patients were examined including complete history and ocular examination. Changes of astigmatism was measured with Auto-refractometer. Fundus examination was done with +90D lens with slit lamp or Indirect Ophthalmoscopy with +20D.Demographics and clinical data including like age, gender, involved eye, type of cataract, type of incision, material used for closing incision and mean changes of astigmatism measured by auto-refractometer. All this data was collected on pre-designed Performa. All data were entered and analyzed into SPSS version 21. Mean±SD was

computed for age and corneal astigmatism of the patients. The qualitative variables, i.e., gender, involved eye pre and post-treatment, type of cataract. Changes of astigmatism pre and postoperatively were compared by using paired t-test. Effect modifiers like age, gender, type of cataract, involved eye were addressed through stratification. Post stratification dependent t-test was applied. P value of ≤0.05 was considered statistically significant.

RESULTS

There are 100 patients who meet the inclusion criteria of the study and whose ages range from 25 to 65 years old. The purpose of the study was to compare the mean changes in corneal astigmatism following phacoemulsification after closing a clear corneal incision by simple hydration. The mean age of the patients was 43.47±11.13 years. The distribution of age is stratified in two groups as presented in **Graph-1**.

There were 54% male and 46% female patients as presented in **Table-1**. There were 59% patients had right eye involved and 41% patients had left eye involved as presented in **Table-1**.



Graph 1: Percentage of Patients According to Age Group (n=100)

Most of patients had immature type of cataract. The incision was observed as 71% had temporal and 29% had superior. The detailed frequency distribution of type of cataract and incision is presented in **Table-1**.

Mean preoperative corneal astigmatism, corneal astigmatism after 1 week and corneal astigmatism after 1 month were found as 1.05±0.05 diopter, 0.69±0.34 diopter and 1.28±0.44 diopter respectively. The detailed descriptive statistics of preoperative corneal astigmatism, corneal astigmatism after 1 week and after 1 month is presented in **Table-2**.

We found a highly significant mean difference in preoperative corneal astigmatism and corneal astigmatism after 1 week (P<0.001). We also found a highly significant mean difference in preoperative corneal astigmatism and corneal astigmatism after 1 month (P<0.001). There is also a highly significant mean difference was observed in corneal astigmatism after 1 week and after 1 month (P<0.001). The detailed mean comparison of preoperative corneal astigmatism, corneal astigmatism after 1 week and after 1 month, is presented in **Table-2**.

Mean difference of preoperative corneal astigmatism, corneal astigmatism after 1 week and after 1 month was also compared for stratified categories of gender, age group, involved eye, type of cataract and type of incision. We found statistically significant mean differences in preoperative corneal astigmatism and corneal astigmatism after 1 week when stratification was done with respect to gender, age group, involved eye, type of cataract and type of incision (p<0.001). The detailed mean comparison of preoperative corneal astigmatism and corneal astigmatism after 1 week and 1 month with respect to gender, age group, involved eye, type of cataract and type of incision presented in **Table-3 to 7**.

We found statistically significant mean differences in preoperative corneal astigmatism and corneal astigmatism after 1 month when stratification was done with respect to gender, age group, involved eye, type of cataract and type of incision (p<0.001) as presented in Table 10 to Table 19. We also found statistically significant mean differences in corneal astigmatism after 1 week and corneal astigmatism after 1 month when stratification was done with respect to gender, age group, involved eye, type of cataract and type of incision (p<0.001) as presented in **Table 3 to 7**.

Table 1: Frequency Distribution of Gender, Eye Involved, Type of Cataract and Type of Incision (n=100)

Variables	Frequency (%)
Male	54 (54%)
Female	46 (46%)
Frequency Distribution of Eye Involved	
Right	59 (59%)
Left	41 (41%)
Frequency Distribution of Type of Cataract	
Immature	70 (70%)
Mature	30 (30%)
Frequency Distribution of Type of Incision	
Temporal	71 (71%)
Superior	29 (29%)
Total	100

Table 2: descriptive statistics and mean comparison of Corneal astigmatisim

	Mean	SD	Minimum Astigmatism	Maximum Astigmatism	Median
Pre-Op	1.05	0.05	1.0	1.1	1.10
1st Week	0.69	0.34	0.1	1.3	0.70
1 Month	1.28	0.44	0.5	2.1	1.30

Table 3: Mean Comparison of Corneal Astigmatism at Pre-Operative, 1 Week and 1 Month for Male and Female

Corneal Astigmatism	Male		Female	
	Mean±SD	P-value	Mean±SD	P-value
Pre-operative	1.05±0.04	<0.001*	1.04±0.05	<0.001*
After 1 week	0.69±0.37		0.68±0.31	
Pre-operative	1.05±0.04	<0.001*	1.04±0.05	<0.007*
After 1 month	1.32±0.44		1.23±0.43	
After 1 week	0.69±0.37	<0.001*	0.68±0.31	<0.001*
After 1 month	1.32±0.44		1.23±0.43	

Paired t- test was applied. *P-value ≤0.05 considered as Significant. **Not Significant at 0.05 levels.

Table 4: Mean comparison of corneal astigmatism at pre-operative, 1 week and 1 month for ≤45 years and >45 years

Corneal Astigmatism	Below 45		Above 45	
	Mean±SD	P-value	Mean±SD	P-value
Pre-operative	1.04±0.05	<0.001*	1.05±0.05	<0.001*
After 1 week	0.72±0.35		0.64±0.33	
Pre-operative	1.04±0.05	0.001*	1.05±0.05	<0.001*
After 1 month	1.25±0.43		1.31±0.45	
After 1 week	0.72±0.35	<0.001*	0.64±0.33	<0.001*
After 1 month	1.25±0.43		1.31±0.45	

Paired t- test was applied. *P-value ≤0.05 considered as Significant. **Not Significant at 0.05 levels.

Table 5: Mean Comparison of Corneal Astigmatism at Pre-Operative, 1 Week and 1 Month for Right Eye and Left Eye

Corneal Astigmatism	Right Eye		Left Eye	
	Mean±SD	P-value	Mean±SD	P-value
Pre-operative	1.04±0.05	<0.001*	1.05±0.05	<0.001*
After 1 week	0.72±0.34		0.64±0.34	
Pre-operative	1.04±0.05	<0.001*	1.05±0.05	0.021*
After 1 month	1.32±0.45		1.21±0.42	
After 1 week	0.72±0.34	<0.001*	0.64±0.34	<0.001*
After 1 month	1.32±0.45		1.21±0.42	

Paired t- test was applied. *P-value ≤0.05 considered as Significant. **Not Significant at 0.05 levels.

Table 6: Mean Comparison of Corneal Astigmatism at Pre-Operative, 1 Week and 1 Month for Immature and Mature Cataract

Corneal Astigmatism	Immature		Mature	
	Mean±SD	P-value	Mean±SD	P-value
Pre-operative	1.05±0.05	<0.001*	1.04±0.05	<0.001*
After 1 week	0.71±0.35		0.64±0.32	
Pre-operative	1.05±0.05	<0.001*	1.04±0.05	0.002*
After 1 month	1.26±0.45		1.32±0.43	
After 1 week	0.71±0.35	<0.001*	0.64±0.32	<0.001*
After 1 month	1.26±0.45		1.32±0.43	

Table 7: Mean Comparison of Corneal Astigmatism at Pre-Operative, 1 Week and 1 Month for Temporal and Superior Incision

Corneal Astigmatism	Temporal		Superior	
	Mean±SD	P-value	Mean±SD	P-value
Pre-operative	1.05±0.05	<0.001*	1.05±0.05	<0.001*
After 1 week	0.70±0.33		0.66±0.36	
Pre-operative	1.04±0.05	0.001*	1.05±0.05	0.001*
After 1 month	1.23±0.43		1.38±0.45	
After 1 week	0.70±0.33	<0.001*	0.66±0.36	<0.001*
After 1 month	1.23±0.43		1.38±0.45	

Paired t- test was applied. *P-value ≤0.05 considered as Significant.

DISCUSSION

Astigmatism occurs when the cornea or lens of the eye has an imperfect curvature. Normal corneas and lenses are smooth and curved equally all around. Light rays are therefore focused sharply onto the retina. Blurred or distorted vision is because of astigmatism. The evolution of cataract surgery from ancient couching to modern phacoemulsification has seen various improvements. A common post-cataract surgery complication is surgically induced astigmatism. There are several advantages to suture less corneal incisions over traditional sutured limbal incisions and scleral tunnels that have gained increasing popularity worldwide. Incisions in the cornea are bloodless and easy to perform, but surgically induced astigmatism (SIA) still poses a risk.[10] The most common surgery in optics is cataract surgery with an intraocular lens (IOL). Micro incisions have replaced extracapsular procedures as a surgical technique over the past few years. This has made cataract surgery less invasive, while improving the predictability of the refractive results. Hence, cataract surgery results are expected to be better for most patients.[11] As a common cataract surgery technique, phacoemulsification is used. Using a handpiece with a titanium or steel tip and an ultrasonic machine, this procedure is performed. The emulsion is achieved by vibrating the tip at the ultrasonic frequency. Emulsification and aspiration of cortical material are made easier by fragmenting into smaller pieces. Using a dual irrigation-aspiration probe, the remaining peripheral cortical materials are aspirated out following phacoemulsification of the lens nucleus. An incision in the corneal scleral membrane (2.2-3.2 mm) is made for the surgery. Injecting the intraocular lens through the slight wound with a lens injector folds the intraocular lens. The suture is not required because the small incision and two-level open wounded heal rapidly and rehabilitation takes less time. Compared to other procedures, this treatment has very little astigmatism, which leads to faster visual improvements. In a few days, the patient will go back to work.[12] With aging, the horizontal corneal meridian becomes curvier than the vertical corneal meridian, which can increase astigmatism from against-the-rule (ATR). Astigmatism shifts with age because of ATR. If a cataract patient has preoperative ATR astigmatism and an incision is placed on the vertical meridian (superior approach), the vertical meridian may be flattened further and the horizontal meridian will be steepened to the same degree as already steep, leading to increased corneal astigmatism following surgery. In these groups of patients, it is important to choose the best location for the incision.[13] There is no need to suture the wound because of its small size and two levels of openings. Wounds heal quickly and take only a short time to heal. The visual improvement is faster because there is no/very little astigmatism.[14] A study by Veronica et al.[18] examined how changes in cataract-induced astigmatism can be calculated in order to achieve better visual results following cataract surgery. A difference in keratometry between preoperative and postoperative measurements can measure SIA. Veronica's study and my results agree in causing astigmatism from corneal incisions and phacoemulsification produces less astigmatism after surgery due to a smaller incision. After cataract surgery and intraocular lens implantation, 151 cataract patients were randomly assigned an intraocular lens inserted through a 3.5 mm incision 5×6 mm oval optic lens inserted through a 5.6 mm incision in an attempt to determine the effects of incision size on early postoperative visual rehabilitation. In cases with 3.5 mm incisions, 62% had an uncorrected visual acuity of 20/40, while in cases with 5.5 mm and 6.5 mm incisions, 33% and 43% were uncorrected vision. All postoperative examinations and surgically induced cylinders were significantly lower for the case with 3.5 mm incision at two days and one week postoperatively. No significant difference was found between the 5.5mm and 6.5mm lenses in terms of visual acuity or astigmatism at any examination. My study is strongly supported by this study.[15–17]

CONCLUSION

The results of our study showed significant mean change of corneal astigmatism from preoperatively to 1 week and also to 1 month. It can be concluded that closing clear corneal incision by simple hydration undergoing phacoemulsification was found effective technique for treatment of corneal astigmatism. To achieve desired results after surgery in patients with astigmatism, phacoemulsification is clinically superior.

REFERENCES

1. Ipe A, Peter G, Skariah R. Reduction in corneal diameter following cataract surgery: A comparison between those who underwent small incision cataract surgery and phacoemulsification at a tertiary care hospital in South India. Int J Sci Study., 2016; 4(1):156-60.
2. Eslami Y, MirmohammadsadeghiA. Comparison of surgically induced astigmatism between horizontal and X-pattern sutures in the scleral tunnel incisions for manual small incision cataract surgery. Indian J Ophthalmol. 2015; 63(7):606-10.
3. Goel R, Nagpal S, Malik KP, Sanoria A. Comparison of surgically induced astigmatism between horizontal and X-pattern sutures in the scleral tunnel incisions for manual small incision cataract surgery. Indian J Ophthalmol. 2016; 64(4):328.
4. Harakuni U, Bubanale S, Smitha K, Tenagi AL, Kshama K, Meena A, et al. Comparison of surgically induced astigmatism with small incision cataract surgery and phacoemulsification. J Evol Med Dent Sci. 2015; 4(71):12354-60.
5. He Y, Zhu S, Chen M, Li D. Comparison of the keratometric corneal astigmatic power after phacoemulsification: clear temporal corneal incision versus superior scleral tunnel incision. J Ophthalmol. 2009; 2009:210621.
6. Jiang Y, Le Q, Yang J, Lu Y. Changes in corneal astigmatism and high order aberrations after clear corneal tunnel phacoemulsification guided by corneal topography. J Refract Surg. 2006; 22(9 Suppl):S1083-8.
7. Puspitasari S, Sitepu B, Delfi. Comparison of astigmatism before and after phacoemulsification with superior versus temporal corneal incisions of senile cataract.int J Sci Res. 2018; 7(4):558-60.
8. Khanzada MA, Lodhi AA, Siyal NA, Mirza SA. Change in preexisting corneal astigmatism after phacoemulsification through clear corneal incision. J LiaquatUni Med Health Sci. 2013; 12(03):151.
9. Fouda S, Kamiya K, Aizawa D, Shimizu K. Limbal relaxing incision during cataract extraction versus photoastigmatic keratectomy after cataract extraction in controlling pre-existing corneal astigmatism. Graefes Arch ClinExpOphthalmol 2010; 248:1029-35.
10. Nikose A, Saha D, Laddha P. Surgically induce astigmatism after phacoemulsification by temporal clear corneal and superior clear corneal approach: a comparison. ClinOphthalmol. 2018; 12:65–70.
11. Garcia Lopez V, Garcia Lopez C, de Juan V, et al. Analysis of cataract surgery induced astigmatism: Two polar methods comparison. Journal of Optometry. 2017; 10(4):252–7.
12. T Thevi C. Outcome of phacoemulsification and extracapsular cataract extraction: A study in a district hospital in Malaysia. Malays Fam Physician. 2014; 9(2):41–7.
13. Arthur E, Sadik A, Kumah D. Postoperative Corneal and Surgically Induced Astigmatism following Superior Approach Manual Small Incision Cataract Surgery in Patients with Preoperative Against–the– Rule Astigmatism. Journal of Ophthalmology. 2016. p. 1–7.
14. Humaira Yasmeen H, Khalil I. Comparison of astigmatism after phacoemulsification and extracapsular cataract extraction. AdvOphthalmol Vis Syst. 2020; 10(3):60-63.
15. Kavitha K, Kishore A, Reddy G. Comparative study of surgically induced astigmatism in superior versus temporal incision in small incision cataract surgery case. International Journal of Research in Medical Sciences. 2015, 3027–31.
16. Patil P, Radhakrishnan O, Rajappa N. Evaluation and comparison of surgically induced astigmatism between phacoemulsification and small incision cataract surgery. Sudanese Journal of Ophthalmology. 2013; 5(2):67.
17. Tejedor J, Pe´rez–Rodri´guez J. Astigmatic Change Induced by 2.8–mm Corneal Incisions for Cataract Surgery. InvestOpthalmol Visual Sci. 2009; 50(3):989.
18. Veronica García-López , Claudia García-López , Victoria de Juan, Raul Martin. Analysis cataract surgery induced astigmatism: Two polar methods comparison. J Optom 2017;10(4):252-257