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Study on Outcome of Phacoemulsification Cataract Surgery with Clear Corneal Steep Axis Incision

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Abstract

A prospective, observational study was conducted in the Department of Ophthalmology, Combined Military Hospital (CMH), Dhaka, Bangladesh, from April to October of 2019, to observe the outcome and determine the amount of surgically induced astigmatism in phacoemulsification cataract surgery done with clear corneal incision. A total of 60 patients were included in this study. Cataract extraction was done in all the patients by phacoemulsification through clear corneal incision with foldable intraocular lens implantation. All the surgeries were done with INTREPID Micro-Coaxial system using the INFINITI Vision system by the same surgeon under local anaesthesia. The patients were followed up on 1st, 7th, and 30th POD. The parameters recorded were uncorrected visual acuity, best-corrected visual acuity, slit lamp examination, and keratometry. Due to clear corneal incision on steep axis, the steep meridian became flat, from 44.329±1.473D (diopter) (as found in pre-operative keratometry) to 43.971±1.431D (on the 30th post-operative day). On the other hand, the flat meridian became steeper from 43.225±1.471D (pre-operative) to 43.225±1.501D (on the 30th day). At preoperative examination and 30th day follow-up visit, astigmatism was determined as 1.10±0.319 and 0.583±0.413 respectively. The change of astigmatism was statistically significant (P<0.05).

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Introduction

Cataract is the leading cause of visual impairment and blindness in the world. There are various methods of cataract extraction, of them small incision cataract surgery (SICS), and phacoemulsification cataract surgery are widely performed.[1] Currently, phacoemulsification with posterior chamber intraocular lens (PCIOL) implantation is the most popular treatment modality for cataract. With the improvement in surgical techniques and the development of new technology, the recovery of visual function after cataract surgery has significantly improved. In the posterior chamber, phacoemulsification reduced endothelial cell loss while viscoelastic protected the cornea.[2] In addition, the advent of foldable intraocular lenses (IOLs) has led to better results.[3] Visual rehabilitation after phacoemulsification largely depends on corneal astigmatism.[4] In astigmatism, the rays of light cannot be made to produce a point image on the retina. Almost all individuals have a minor degree of physiological astigmatism. Around 50% of people have astigmatism of about 0.25-050 dioptre (D). Astigmatism can be classified into regular and irregular astigmatism.[2] With the

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shortening of corneal tunnel incisions from 5.5 mm to 3.2 mm, 2.8 mm, 2.4 mm, and 2.2 mm, visual function postoperatively has steadily increased. Hence, smaller incisions provide less astigmatism as well as better self-sealing of the wound.[5-8] Various surgical treatments for pre-existing corneal regular astigmatism have been tried over time.[7] The incision on the steep axis of corneal astigmatism is one of the most popular methods of correcting pre-existing astigmatism.[7,8] Here, we adopted phacoemulsification and PCIOL implantation with the 2.4 mm clear corneal incision. The goal was to improve the quality of the visual outcome after phacoemulsification surgery through a clear corneal incision.

Methods

This prospective, observational study was conducted in the Department of Ophthalmology, Combined Military Hospital (CMH), Dhaka Cantonment, Dhaka, Bangladesh, between April and October of 2019.

Inclusion criteria:

1. unilateral or bilateral age-related cataract,
2. between 40 and 75 years of age.

Exclusion criteria:

1) complicated cataract,
2) surgery accompanied with complication,
3) other associated ocular pathology e.g., pterygium,
4) irregular astigmatism e.g., keratoconus,
5) ocular trauma,
6) if the patient is unwilling to go through the procedure,
7) any cognitive disorder or psychiatric issues.

A total of 60 patients who fulfilled the selection criteria for phacoemulsification cataract surgery with IOLs implantation were included in the study. Under local anaesthesia, proper surgical toileting of the operation field was done with 5% povidone iodine and draped with sterile sheets and eye drapes.

After properly exposing the operative field, the main incision was given. The clear corneal tunnel incision was performed with the side-port at 70 degree apart and to the left side of the main incision. The tunnel incision was done in all patients with a 2.4 mm Webal Edge knife and the side port with a 1.2 mm Webal edge knife. After continuous curvilinear capsulorrhexis and hydro-dissection, the nuclear rotation and emulsification were done. In all patients, a 0.9 mm mini-flared ABS Kelman tip with a 45 degree bevel was used for phacoemulsification.[8] The cortical matter was removed by irrigation and aspiration techniques. Then a foldable IOL was implanted in the capsular bag. All incisions were left suture-less and were sealed by corneal stromal hydration. Patients' follow up was done on the 1st, 7th and 30th postoperative days (POD). A slit lamp examination and ophthalmoscopy were done routinely.

Data was collected in a predesigned data collection sheet. All the data were double-checked, compiled, and sorted properly. Appropriate statistical analysis was done using computer-based SPSS (Statistical Package for Social Science) software version 26.0, for windows.

Results

A total of 60 patients were included in the study. Their age ranged between 40 and 75 years and most of the patients belonged to 52-63 years age

group. Among the study patients, males were 42(70%) and females were 18(30%) and the male-to-female ratio was 2.3:1. Preoperative visual acuity was found as hand movement in 4(6.66%) patients, counting fingers in 10(16.7%), while the maximum 32(55.5%) visual acuity of the study population was 6/60 (Table-I). On the 1st POD, only 43.33% of patients regained 6/6 vision (Table-II). On the 7th POD, 53.3% of patients had 6/6 vision (Table-III). On the 30th POD, 66.66% of patients had 6/6 vision (Table-IV). Table-V shows that keratometry readings of the steep axis were declining, while flat axis readings were increasing over time from its pre-operative status to 1st, 7th and 30th POD. Similarly, astigmatism gets lower over time as 1.10±0.319, 0.954±0.494, 0.708±0.407, 0.583±0.413 found preoperatively and on the 1st, 7th and 30th POD respectively (Table-V).

Table-I: Preoperative visual acuity of the patients (n=60)

Visual Status	Frequency	Percentage
Hand Movement (HM)	4	6.66
Counting Finger (CF)	10	16.7
6/60	32	55.5
6/36	12	18.1
6/24	2	3.3

Table-II: Visual acuity of the patients on the 1st POD (n=60)

Visual Status	Frequency	Percentage
6/24	2	3.33
6/18	2	3.33
6/12	10	16.66
6/9	20	33.33
6/6	26	43.33

Table-III: Visual acuity of the patients on the 7th POD (n=60)

Visual Status	Frequency	Percentage
6/18	2	3.33
6/12	2	3.33
6/9	24	40.0
6/6	32	53.3

Table-IV: Visual acuity on the 30th POD (n=60)

Visual Status	Frequency	Percentage
6/12	4	6.66
6/9	16	26.66
6/6	40	66.66

Table-V: Preoperative and Postoperative keratometric comparison of the patients (n=60)

Variables	Pre-Operative Mean± SD	Post-operative Mean±SD		
		1st POD	7th POD	30th POD
Steep axis	44.329± 1.473 D	44.196± 1.419 D	44.033± 1.404D	43.971± 0.431 D
Flat axis	43.225±1 .471 D	43.223± 1.515D	43.333± 1.492D	43.421± 1.501 D
Astigmatism	1.10± 0.319	0.954± 0.494	0.708± 0.407	0.583± 0.413

Discussion

Cataract surgery is one type of refractive surgery.[9] Corneal astigmatism plays an important role in the ultimate post-operative visual status of the patient. The visual status of an individual depends not only on visual acuity but also on field of vision, colour vision, contrast sensitivity, glare sensitivity, and binocularity. Astigmatism not only causes decreased visual acuity for distance and near but also lowers contrast sensitivity, decreases reliability and variability of measurements, and hampers reading speed.[2,7] As a result, an astigmatic person's vision is not as

good as that of those who do not have astigmatism. Therefore, astigmatism significantly affects a patient's independence, quality of life, and well-being.[7]

The change in the keratometric cylinder was examined by the simple subtraction method of calculating cylinders without regard to axis. Due to a clear corneal incision on the steep axis, we found that the mean (±SD) steep meridian became significantly flatter from preoperative keratometry 44.329 (±1.473) D to the 30th POD keratometry 43.971(±1.431) D. On the other hand, the mean (±SD) flat meridian became steeper from preoperative keratometry 43.225(±1.471) D to 30th POD keratometry 43.421(±1.501) D. Therefore, the pre-existing astigmatism reduced gradually over time. This study was compatible with the study done by Beltrame *et al*.; they showed significant wound-related flattening and non-orthogonal steepening in 2 opposite radial sectors induced by different oblique cataract incisions.[10]

We found that preoperative mean (±SD) astigmatism was 1.104(±0.319) D. During postoperative follow-up on the 1st, 7th, and 30th PODs, mean astigmatism decreased to 0.954±0.494 D, 0.708±0.407 D, and 0.583±0.413 D respectively. Thus, the mean preoperative astigmatism decreased significantly in the successive postoperative days. This study was compatible with the findings of Borasio *et al*., who showed the on-axis CCI induced flattening of the meridian of the incision at a mean of 0.63 D; however, the results were observed after eight weeks.[11] Another study was done in the same institution and observed similar findings, i.e., after cataract surgery astigmatism was significantly decreased over time.[12]

Conclusion

Cataract surgery as a form of refractive surgery demands uncorrected, high-quality vision postoperatively. Ophthalmologists planning to provide quality vision for the patient after cataract surgery by phacoemulsification would be prudent to adopt the best-suited procedure to minimize the pre-existing astigmatism for the individual patient. As a result, in phacoemulsification surgery, an on-axis clear corneal incision may be a good option for significant correction of pre-existing corneal astigmatism. We had some limitations in our study. The follow-up schedule was short, and the sample size was small. Hence, the results could not be generalized for the country's population. We recommend further studies with larger samples with longer duration and in multi-centre to draw a better inference.

References

1. *Kanski JJ, Bowing B. Clinical ophthalmology: a systematic approach. 7th edition. London: Elsevier; 2011. p.281-5.*
2. *American Academy of Ophthalmology (AAO). Lens and Cataract. 2017-2018 Basic and Clinical Science Course. Section 11. USA: AAO; 2017. p.69-88.*
3. *Marcos S, Barbero S, Jiménez-Alfaro I. Optical quality and depth-of-field of eyes implanted with spherical and aspheric intraocular lenses. J Refract Surg. 2005;21(3):223-35.*
4. *Amesbury EC, Miller KM. Correction of astigmatism at the time of cataract surgery. Curr Opin Ophthalmol. 2009;20(1):19-24.*
5. *Long DA, Monica ML. A prospective evaluation of corneal curvature changes with 3.0- to 3.5-mm corneal tunnel phacoemulsification. Ophthalmology. 1996;103(2):226-32.*

6. *Hayashi K, Hayashi H, Nakao F, Hayashi F. The correlation between incision size and corneal shape changes in sutureless cataract surgery. Ophthalmology. 1995;102(4):550-6.*

7. *Núñez MX, Henriquez MA, Escaf LJ, Ventura BV, Srur M, Newball L, et al. Consensus on the management of astigmatism in cataract surgery. Clin Ophthalmol. 2019;13:311-24.*

8. *Buckhurst PJ, Wolffsohn JS, Davies LN, Naroo SA. Surgical correction of astigmatism during cataract surgery. Clin Exp Optom. 2010;93(6):409-18.*

9. *Kelman CD. Phaco-emulsification and aspiration: a new technique of cataract removal: a preliminary report. Am J Ophthalmol. 2018;191:xxx-xi.*

10. *Beltrame G, Salvetat ML, Chizzolini M, Driussi G. Corneal topographic changes induced by different oblique cataract incisions. J Cataract Refract Surg. 2001;27(5):720-7.*

11. *Borasio E, Mehta JS, Maurino V. Surgically induced astigmatism after phacoemulsification in eyes with mild to moderate corneal astigmatism: temporal versus on-axis clear corneal incisions. J Cataract Refract Surg. 2006;32(4):565-72.*

12. *Hasan MM, Begum H, Hasan AKMR. Effects of corneal incision on steep meridian with preexisting astigmatism in cataract surgery by phacoemulsification. Community Based Med J. 2023;12(1):27-32.*