

Outcome of Pre-Existing Corneal Astigmatism by Incision at Steep Axis in a tertiary care hospital

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ABSTRACT

Purpose: To measure post-surgical astigmatic correction through phacoemulsification at steep axis.

Type of study: Quasi-experimental

Sampling technique: Non-Randomized consecutive sampling

Materials and Methods: This quasi-experimental study was performed on 460 eyes of 350 patients of cataract reporting at Eye Department, Combined Military Hospital (CMH), Lahore from Oct 2010 to Dec 2011 who had pre-existing corneal astigmatism. They were managed by phacoemulsification with corneal incision at steep axis to extract cataract and correct astigmatism.

Results: Induced refractive change caused by corneal incision at steep axis showed an overall improvement in pre-operative astigmatism with minimum level of significance

Conclusion: Corneal incision at steep axis is an effective technique to reduce pre-operative astigmatism

Keywords: Astigmatism, steep axis, phacoemulsification, with the rule astigmatism

INTRODUCTION

In addition to improving visual acuity (VA), one of the goals of modern cataract surgery is to reduce pre-existing astigmatism (PEA), a factor that may reduce VA and affect the quality of vision. A 3.2-mm clear corneal phacoemulsification incision results in a surgically induced astigmatism (SIA) of 0.5 D (95% CI: 0.4–0.6 D)¹. Hill suggests that incisions that are 2.4 mm in length may not change astigmatism significantly, perhaps as a result of wound-stretching during IOL insertion². Accordingly, for patients with less than 1 D of pre-existing corneal astigmatism, placing the phacoemulsification incision on the steep meridian of corneal astigmatism is the ideal approach. The surgeon must be capable of moving the phacoemulsification incision to different meridians and comfortably operating at different positions around the patient's head. As regards the choice of incision site/location, previous studies reported that superior incision induces greater corneal astigmatic change (against-the-rule astigmatism-ATR), than temporal incision (which induces with-the-rule astigmatism-WTR)^[3-5]. In addition, with-the-rule astigmatism is preferred as it frequently allows better uncorrected visual acuity⁶. Others recommend choosing the location of corneal incision based on preexisting astigmatism by placing the incision on the steeper corneal meridian (on-axis incision) to reduce significant preoperative astigmatism⁷.

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MATERIALS AND METHODS

This study was carried out at CMH, Lahore. A total of 460 eyes of 350 patients were included in the study. They were having age related cataract with regular corneal astigmatism. Preoperatively, a detailed history of ocular & systemic associations was taken. A full ophthalmic examination was done including uncorrected visual acuity (UCVA), best-corrected visual acuity (BCVA), complete examination of anterior and posterior segments using slit-lamp biomicroscopy, applanation tonometry and systemic evaluation of every patient was done. Keratometry and 'A-scan' biometry was performed. Keratometry was performed using automated keratometer (Canon) to determine preoperative corneal astigmatism). Power of posterior chamber IOL was calculated by using SRK-II/SRK-T formulae after recording keratometric (K1 and K2) readings and axial length measurements. All patients also signed an informed consent.

All surgeries were performed by a single surgeon using topical/peribulbar anaesthesia. Incision site was marked using astigmatic marker on the conjunctiva in the upright sitting position preoperatively to avoid torsional effect of oblique muscles. Clear corneal incision of 3.2 mm was made at steep axis one mm anterior to the limbus. Cataract was extracted by conventional phacoemulsification and foldable IOL was implanted within the capsular bag. Corneal wound was hydrated (without stitch application). Patients were advised to instill antibiotic and steroid eye drops for 3-4 weeks post-operatively.

Post-operative visits were planned as follows:-

- 1st visit: Same evening
- 2nd visit: 1st post-op day
- 3rd visit: 1 weeks
- 4th visit: 4 weeks
- 5th visit: 3 month

Data was analyzed by using SPSS version-17.0. Mean and standard deviation (SD) were calculated for pre-operative and post-operative astigmatism at 4th weeks. Paired sample 't' test was used to compare pre and post operative astigmatism within the group. Independent sample 't' test was also used to compare post-operative change in corneal astigmatism at 4th week. A p-value of < 0.05 was considered as statistically significant.

Exclusion criteria:

- Complicated cataract, and pseudo exfoliation.
- Pre-existing pathology other than cataract causing diminution of vision such as corneal opacities, scar/degenerations, uveitis, glaucoma, macular and optic nerve disorders.
- Any patient who had undergone previous ocular surgery (trabeculectomy, refractive or retinal detachment surgery)
- Pre-operative astigmatism of more than 2 diopters

RESULTS

460 eyes were included in this study which underwent clear corneal incision applied on the steep axis and its effect on post-operative refractive status was recorded. 53.9 % of the patients were males while 45.7% were females. Mean age of the patients was 65.14±SD7.461 years as shown in Table 2. By applying paired samples t-test, mean pre-operative astigmatism in diopters was calculated as 0.9087±SD0.49323, while post-operative mean astigmatism came out to be 0.5353±SD0.22135, keeping value of significance at minimum, as shown in Table 2. Net difference in pre-operative astigmatism brought about by incision at steep axis came out to be -0.3511±SD0.46833 diopters. The incision was therefore, found out to be effective in reducing pre-operative astigmatism significantly; thus providing a better post-operative visual acuity.

Table 1: Gender of the patients.

Male	249	53.9
Female	211	45.7
Total	462	100

Table 2: Mean Pre-existing (pre-operative), Post-operative and Net astigmatism

	N	Min.	Max.	Mean	Std. Deviation
PE asigmatism in diopters	460	.25	2.00	.9087	.49323
PO astigmatism in diopters	460	.25	1.75	.5353	.22135
Net difference	460	-1.50	1.75	-.3511	.46833
age in years	460	45	87	65.14	7.461

DISCUSSION

Today's cataract incisions provide better control of surgically induced astigmatism, either by using temporal approach to produce "astigmatically neutral" surgery or by using on-axis incision to induce astigmatism at the steep axis to counteract preexisting astigmatism. Astigmatism is that form of refractive error in which parallel rays of light, along the optical axis, do not form a point focus but form focal lines, due to different refractive power in different meridians when accommodation is at rest. The condition of astigmatism was first suggested by Sir Isaac Newton in 1727. Then it was Thomas Young a versatile scientist, who carried out a detailed investigation of this optical error in 1801. He himself had about 1.7D of astigmatism which did not change on immersing his head in water. So he attributed his defect to the lens. Airy in 1827 was the first person to use a cylindrical lens to correct an astigmatic defect. Donders, however, was the one who in 1864 explained to the ophthalmological world, the prevalence and importance of this refractive error⁸.

On the basis of the magnitude of astigmatism measured by keratometry & corneal topography, a systematic stepwise approach to surgical astigmatism correction should be adopted⁹. Toric lenses are used to correct preexisting astigmatism of larger degree but being expensive, they can be used only in a limited number of cataract patients¹⁰. Similarly, arcuate keratotomy (600 micrometer deep) can be performed at steep axis during phaco surgery but the results are unpredictable¹¹. Limbal relaxing incisions of variable length can also be given post-operatively to correct the astigmatism but it carries all the problems and risks associated with additional surgery¹². Excimer laser may also be performed post-operatively but again it is expensive and carries all the risks of refractive corneal surgery¹³.

Several studies have been conducted in the past regarding effects of phaco-incision on pre-operative corneal astigmatism. Manipulation of wound during phaco surgery is a simple and effective procedure to correct relatively minor degrees of astigmatic error e.g. for less than 1.00 D of astigmatism, the phaco incision can be placed on the steep axis¹⁴. This is accomplished by centering the incision on the steep corneal meridian. By varying incision size and design, the surgeon can produce a desired amount of wound flattening to decrease cylinder. Surgeons should determine the effects of their incisions on surgically induced astigmatism. A good general rule is that a 3.2-mm clear corneal phaco incision results in surgically induced astigmatism of 0.50 D (95% confidence interval of 0.40 to 0.60 D)¹⁵. Hill suggests that incisions less than 2.4 mm wide do not reduce surgically induced astigmatism much below 0.50 D, as these incisions stretch during IOL implantation.¹⁶ For patients receiving monofocal IOLs with less than 1.00 D of pre-existing corneal astigmatism, an incision on the steep axis is usually sufficient to correct the astigmatic error¹⁷.

CONCLUSION

Incision at steep axis is effective in reducing pre-operative astigmatism by almost 0.35 diopters is statistically significant. It is therefore a reliable technique which should be applied by surgeons to improve the post-operative visual outcome.

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