Original Article

Phacoemulsification Pak Armed Forces Med J 2011; 61 (4): 566-9

# EFFECTS OF 5.5 MILLIMETERS CLEAR CORNEAL TEMPORAL VERSUS STEEPEST MERIDIAN PHACOEMULSIFICATION INCISION ON PREEXISTING CORNEAL ASTIGMATISM

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## ABSTRACT

***Objective:*** To compare the effects on astigmatism of 5.5 mm clear corneal phaco-incision at steepest meridian (group A) with uniformly selected temporal site (group B).

***Design*** Randomized control trial (RCT)

***Setting:*** Armed forces institute of ophthalmology Rawalpindi (AFIO).

***Duration:*** January 2007 to December 2007.

***Subjects:*** One hundred cases were enrolled and randomly divided into two groups, 50 in each group.

***Methods:*** Subjects were divided by simple random method (lottery method) into two groups, group A and B. Cataract surgery was performed by phaco and PCIOL was implanted. In group A, incision was made on steepest meridian. While in group B, incision was made on uniformly selected temporal site (irrespective of steepest meridian).

***Results:*** On 12th post-operative week corneal astigmatism of group A (1.46±0.377) was significantly ($p$<0.05) less than pre-operative astigmatism (2.151±0.404). For group B, difference between 12th week post-operative (1.73±0.344) and pre-operative astigmatism (2.03±0.342) was also statistically significant but the effects of phaco-incision in reducing pre-corneal astigmatism was much superior in group A than in group B. The difference was statistically significant at $p$<0.05.

***Conclusion:*** Steepest meridian phaco-incision results in significant decrease in pre-operative astigmatism than routine phaco-incision on temporal side.

**Keywords:** Phacoemulsification, Corneal astigmatism, phaco-incision.

## INTRODUCTION

Cataract surgery has become one of the most common and successful procedures in ophthalmology. Modern cataract surgery aims not only to improve vision but also to provide a good unaided visual acuity. Correcting astigmatism is now an integral part of such operations. Astigmatism is that condition of refraction wherein a point focus of light cannot be formed upon the retina. Theoretically no eye is without astigmatism but in practice we include under this form of ametropia those anomalies in optical mechanism wherein an appreciable error is caused by the unequal refraction of light in different meridians[1]. It is generally noticed that the incidence of post-operative astigmatism is more when cataract extraction is done through the corneal incision and more anterior is the incision the greater will be the induced astigmatism. It is considered that phaco without sutures produce less post-operative astigmatism than phaco with sutures. Therefore it gives early recovery and better unaided visual acuity with improved patient satisfaction[2].

Different factors affecting post-operative astigmatism include incision size and shape[3, 4,5,] location relative to the limbus[6], suture technique and material. Numerous studies have been carried out regarding the best possible location, type and width of the incision and their effect on the flattening of the cornea in order to correct / decrease the PEA[7].

Clear corneal incision (CCI) can induce astigmatism of 0.5–1.75 D one year post-operatively[8] and many surgeons make the incision in the steepest meridian in order to correct pre-existing astigmatism (PEA). This study was aimed at devising the technique for correcting pre-operative astigmatism and improving the unaided visual outcome.

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*Received: 06 Sep 2010; Accepted: 20 Jan 2011*

## MATERIALS AND METHODS

These randomized controlled trials (RCT) were carried out at Armed Forces Institute of Ophthalmology (AFIO) Rawalpindi from January 2007 to December 2007. A total 0f 100 patients (100 eyes) having age related cataract with regular corneal astigmatism of at least 01D with out previous eye surgery and no pre existing ocular disorder or controlled systemic disease were included. They were divided into two groups A and B by simple random method (lottery method). A detailed history, complete examination of anterior and posterior segments and systemic evaluation of every patient was done according to the same protocol. Power of posterior chamber IOL was calculated by using SRK-II formula after recording keratometric (K1 and K2) and axial length measurements.

All surgeries were performed by using Topical / periobulbar anaesthesia. Clear corneal incision of 3.2 mm was made (in the steepest meridian in group A and uniformly selected temporal side in group B). Cataract was extracted, incision was enlarged up to 5.5 mm and PMMA PC IOL (5.25mm) was implanted within the capsular bag. Corneal wound was hydrated where required (without stitch application). Patients were advised to instill antibiotic and steroid eye drops for 2-4 weeks post-operatively. Post-operative visits were planned as follows:-

1st visit at 4 weeks

2nd visit at 8 weeks

3rd visit at 12 weeks

If at any stage of surgery a complication occurred, that case was excluded from the study.

Data were analyzed by using SPSS version-10.0. Mean and standard deviation (SD) were calculated for pre-operative and post-operative astigmatism on 4th, 8th and 12th post-operative week in both groups. Frequency and percentages were calculated for age category (≤49 years, 50-60 and 61-70 years), gender and eye (Rt/Lt). Paired sample't' test was used to compare pre and post operative astigmatism within each group. Independent sample't' test was also used to compare post-operative change in corneal astigmatism at 12th week between group A and group B. A *p*-value of < 0.05 was considered as statistically significant.

## RESULTS

Out of 100 patients, 50 were included in group A and 50 in group B. Both the groups were comparable with respect to age gender and eye (Table 1,2,3)

Pre and post operative astigmatism were compared within each group (group A and group B). *p*-value was <0.001 in all the three post-operative readings on 4th, 8th and 12th post-operative week in both groups. (Table-4)

Change in corneal astigmatism from baseline to to 12th week in group A was 0.684±0.027 while in group B it was 0.296±0.002 E-02. This difference was statistically significant (*P*<0.001)

**Table-1: Age distribution of patients**

| Age (Years) | Group A (n=50) | Group B (n=50) |
|---|---|---|
| ≤49 yrs | 3 (6%) | 2 (4%) |
| 50-60yrs | 33 (66%) | 30 (60%) |
| 61-70yrs | 14 (28%) | 18 (36%) |

*P*= 0.656

**Table 2: Gender distribution of patients**

| Gender | Group A (n=50) | Group B (n=50) |
|---|---|---|
| MALE | 28 (56%) | 29 (58%) |
| FEMALE | 22 (44%) | 21 (42%) |
| M : F | 1.3 : 1 | 1.3 : 1 |

*P*= 0.840

**Table-3: Distribution of eyes (rt /lt)**

| Eyes | Group A (n=50) | Group B (n=50) |
|---|---|---|
| RIGHT | 27 (54%) | 30 (60%) |
| LEFT | 23 (46%) | 20 (40%) |

*P*= 0.544

**Table 4: Corneal astigmatism before and after surgery (Values are given as mean ± SD)**

| Astigmatism (in diopters) | Group A (n=50) | *P* Value | GROUP B (n=50) | *P*-Value |
|---|---|---|---|---|
| Pre-operative | 2.151 ± 0.4047 | | 2.028 ± 0.342 | 0.06 |
| 4th post-op week | 1.489 ± 0.369 | < 0.001 | 1.737 ± 0.344 | < 0.001 |
| 8th post-op week | 1.483 ± 0.387 | < 0.001 | 1.739 ± 0.344 | < 0.001 |
| 12th post-op week | 1.467 ± 0.377 | < 0.001 | 1.732 ± 0.344 | < 0.001 |

## DISCUSSION

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[9] 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 error.

Several studies have been conducted in past regarding effects of phaco-incision on pre operative corneal astigmatism.

Matsumoto et al. enrolled 142 patients to determine the optimal incision to eliminate astigmatism after cataract extraction[10]. They concluded that to prevent astigmatism postoperatively, the incision should be placed at the steepest meridian in eyes with preoperative astigmatism greater than 0.5 D. For preoperative astigmatism greater than 1.2 D, a 3.2 mm incision at the corneal limbus is insufficient and a wider incision or an additional incision is required. The results of this study support the results of our study in which, the decrease in corneal astigmatism is more when larger incision (5.5mm) is made on steepest meridian.

Borasio et al.[11] performed randomized controlled clinical trial on 62 eyes with cataract and mild to moderate corneal astigmatism (<2.60 diopter]) having phacoemulsification with a temporal clear corneal incision (CCI) (temporal group) or on-axis clear corneal incision (CCI) (on-axis group), suggesting that in eyes with preoperative astigmatism less than 2.60 D, on-axis CCI phacoemulsification induced slightly more flattening along the incision meridian than temporal CCI phacoemulsification. At three weeks after surgery, the on-axis CCI induced slightly more flattening of the meridian of the incision (mean -0.63 +/- 0.57 D) than the temporal CCI (mean -0.50 +/- 0.44 D).

Müller-Jensen and Schüler M.[12] performed a study with the aim of using corneal incisions in cataract surgery for neutralization of preoperative astigmatism. Sixty one patients with preoperative astigmatism of 2.25 +/- 0.98 were enrolled. A self-sealing corneal tunnel incision measuring 4.0 to 4.1 mm in external diameter and 6.5 to 7.0 mm in internal diameter (stretch incision) was performed on the steeper axis and the results suggested that surgical induced astigmatism (SIA) following superior incisions in cases of astigmatism with the rule (n = 29) amounted to 1.93 +/- 0.97, while lateral incisions in cases of astigmatism against the rule (n = 29) led to an IA of 1.35 +/- 0.73. They concluded that with a 4 mm corneal cataract incisions on the steeper axis, a high preoperative astigmatism can be reduced significantly without additional keratotomies. This result strongly support the results of our study (change in corneal astigmatism was 0.684 D in group A and 0.291 D in group B at 12th postoperative week follow up) except that the follow up period was longer (1yr).

Our study has evaluated the local population for change in pre-operative astigmatism after cataract extraction by phacoemulsification (5.5 mm incision). It showed that a significant change in corneal astigmatism occurs if incision is made on steepest axis as compared to same incision made on temporal side irrespective of axis. Our study might have benefited from: (1) a longer follow-up to evaluate the long-term effect of clear corneal incision (CCI) on steepest meridian in correcting PEA. (2) repeated keratometry measurements (preferably computerized video-keratometry) at different intervals, to ascertain the astigmatic changes over time and (3) use of different sizes of CCI incisions (3.2–6.5mm) to establish the effect of incision size on astigmatism correction.. There is a need of multicenter studies to be performed by collaboration of various institutes in

different cities to confirm these associations and to plan strategies that would be effective in reducing refractive error post-operatively in routine cataract surgery.

## CONCLUSION

Cataract extraction by phacoemulsification with steepest meridian incision, results in statistically significant reduction in post operative corneal astigmatism in cases of regular corneal astigmatism.

Refractive corneal surgery is not free of potential complications so its very beneficial for the patients to have cataract as well as refractive surgery with same procedure. Patients must be worked up thoroughly before cataract extraction to avoid undesirable results.

## REFERENCES


1. American Academy of Ophthalmology. Optics, refraction, and contact lenses, 1999 - 2000. San Francisco: The Academy, 1999.
2. Raja N, Niazi KM. Phacoemulsification versus extra capsular cataract extraction: the visual out come. Pak J Surg 2003; 19:77-81.
3. Beltrame G, Salvetat ML, Chizzolini M, Driussi G. Corneal topographic changes induced by different oblique cataract incisions. J Cataract Refract Surg 2001; 27:720–727.
4. Hayashi K, Hayashi H, Nakao F, Hayashi F. The correlation between incision size and corneal shape changes in suture less cataract surgery. Ophthalmology 1995; 102:550–556.
5. Samuelson SW, Koch D, Kuglen CC. Determination of maximal incision length for true small-incision surgery. Ophthalmic Surg 1991; 22: 204–207.
6. Singer J. Frown incision for minimizing induced astigmatism after small incision cataract surgery with rigid optic intraocular Iens implantation. J Cataract Refract Surgery 1991; 17: 677-678.
7. Kock DD, Haft E A, Gay C. Computerized video karatographic analysis of corneal topographic changes induced by sutured and unsutured 4mm scleral pocket incisions, J Cataract Refractive Surgery 1993; 19: 166-169.
8. Nielsen P. Prospective evaluation of surgically induced astigmatism and astigmatic keratotomy effects of various self-sealing small incisions. J Cataract Refract Surg 1995; 21:43–48.
9. Elder D. Practice of Refraction. 10th ed. London: Churchill Livingstone, 1993.
10. Matsumoto Y, Hara T, Chiba K, Chikuda M. Optimal incision sites to obtain an astigmatism-free cornea after cataract surgery with a 3.2 mm sutureless incision. J Cataract Refract Surg. 2001; 27: 1615-9.
11. Borasio E, Mehta JS, Maurino V. Torque and flattening effects of clear corneal temporal and on-axis incisions for phacoemulsification. J Cataract Refract Surg. 2006 ; 32: 2030-8.
12. Müller-Jensen K, Schüler M. Reduction of astigmatism by 4mm long sutureless corneal cataract incision (stretch incision) with phacoemulsification and 5mm PMMA lens implantation. Klin Monatsbl Augenheilkd. 1998; 212: 428-32.