Comparison of Astigmatism Correction After On Axis Incision and an Additional Limbal Relaxing Incision During Phacoemulsification

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Summary
Managing preoperative and surgically induced astigmatism along with phacoemulsification cataract surgery is essential for optimum visual outcome. The main objective of this presented research was to compare the amount of astigmatism correction obtained by giving a clear corneal incision on the steepest axis vs. that obtained by giving an additional Limbal Relaxing Incision (LRI). The conclusion drawn from this research was Limbal Relaxing Incision can reduce the pre-existing astigmatism of mild to moderate degree of up to 1.00 D with predictable accuracy when combined with phacoemulsification.

Keywords: astigmatism, limbal relaxing incision, on-axis incision

Introduction
The emerging standard in cataract surgery today extends beyond safe cataract removal and intraocular lens implantation to include simultaneous management of pre-existing astigmatism. Also, control of surgically induced astigmatism after cataract extraction is a crucial element in achieving the optimal visual result. Various options like Incision size and meridian; additional limbal relaxing incision (LRI) using keratome or femto laser; use of toric lenses for implantation are being tried to achieve this aim. In our study we evaluated the efficacy of limbal relaxing incisions in correcting pre-existing astigmatism. We observed that LRIs are not only effective in reducing astigmatism after cataract surgery but also when combined with on-axis incision during phacoemulsification reduce the pre-existing corneal astigmatism significantly.

Materials & Methods
It was a randomised prospective interventional study. Forty cases with healthy cornea, normal peripheral corneal thickness, having 1.50D to 4D against the rule astigmatism as measured by keratometry and senile cataract undergoing phacoemulsification were selected for the study. The cases were randomised into group A and B of twenty each. Group A patients were subjected to 3.2 mm on axis clear corneal incision in the steepest meridian. In group B patients were subjected to 3.2 mm on axis clear corneal incision in the steepest meridian and additional limbal relaxing incision. Phacoemulsification was performed by the same surgeon using similar parameters for all the cases. Using NAPA nomogram the meridian for LRI was identified and incision of 600 microns depth was given. All the cases in both groups were re-examined for keratometric astigmatism on 2nd day, 1 week, 1 month, 2 months and 3 months postoperatively. A comprehensive ocular examination was done for the patients at each visit. All data was carefully accumulated, arranged and assessed statistically to derive significant conclusions. The Wilcoxon signed rank test was used for intra-group analysis and Mann Whitney U test for inter-group analysis conducted using SPSS software.

Results
In group A the mean preoperative astigmatism was 1.96D. Corneal astigmatism values were 1.41D on 2nd day, 1.38D on 7th day, 1.43D at 1 month, 1.50D at 2 month and 1.64D at 3 month postoperatively. The average reduction of astigmatism in this group was 0.33 D with a maximum reduction of 1.25 D and no change in corneal astigmatism was observed in three patients. A statistically significant reduction in the pre-existing corneal astigmatism (p=0.034) was observed.
In group B the mean preop astigmatism was 2.19D. Corneal astigmatism values were 1.26D on 2nd, 1.30D on 7th, 1.18D at 1 month, 1.23D at 2nd month and 1.24 at 3rd month postoperatively. The average reduction of astigmatism in this group was 0.95 D with a maximum reduction of 1.25 D and no change in corneal astigmatism was observed in three patients. A statistically significant reduction in the pre-existing corneal astigmatism (p=0.034) was observed.

The average age and average preop astigmatism between

![Figure 1: Distribution of average preop and postop corneal astigmatism](image-url)
the two groups was not statistically significant. The average post operative astigmatism at 3 months was lesser in group B. There was a greater statistically significant reduction of preoperative astigmatism in Group B in comparison to Group A (p=0.0012). (Table 1)

Table 1: Comparison of group A Vs group B

| Parameter                     | Group A | Group B |
|-------------------------------|---------|---------|
| No. of patients               | 20      | 20      |
| Mean age (years)              | 62.15   | 61.25   |
| Average preop astigmatism (D) | 1.96    | 2.18    |
| Average postop astigmatism at 1 month (D) | 1.54 | 1.18 |
| Average postop astigmatism at 3 months (D) | 1.64 | 1.24 |
| Reduction in astigmatism (D)  | 0.33    | 0.95    |

Discussion

Managing preoperative and surgically induced astigmatism is essential for optimum visual outcome post phacoemulsification. Various options like incision size and meridian; additional LRI using keratome or femto laser; use of toric lenses for implantation are being tried to achieve this aim. One method of correcting preexisting astigmatism during phacoemulsification is by giving an on axis incision. Motsumoto et al, by placing 3.2 mm corneal limbus incision at the steepest meridian in eyes with preop astigmatism >0.5D resulted in astigmatism free eyes postoperatively.3 They also suggested that in cases of preoperative astigmatism >1.2 D an additional incision was required. We in our study found that there was a significant reduction in the postoperative astigmatism by placing 3.2 mm Clear Corneal Incision on the steepest corneal axis (On Axis Incision) in group A (p=0.034). Limbal relaxing incisions are helpful in correcting preexisting corneal astigmatism during phacoemulsification with IOL implantation. Wang et al concluded that the clear corneal incisions with Peripheral Clear Corneal Incision during phacoemulsification decreased the preexisting astigmatism significantly.2 In their study the percentage of eyes with corneal astigmatism <1D increased from 6% preoperatively to 51% at 4 months post operatively. Kaufmann et al observed a mean reduction of astigmatism by 25%, and Carvalho et al observed a reduction of 50%.34 In our study we observed a significant decrease in the corneal astigmatism in cases with corneal astigmatism of greater than 1.50 D-4.0 D that underwent phacoemulsification with incision at the steep axis and an additional LRI (p=0.0003). The mean reduction of astigmatism at 3 months postop was 43.4%. The technique of LRI has varied from one center to another. Wang et al advocated the use of a diamond knife set at a depth of 600 microns to perform LRI.2 Nichamin LD suggested the use of an empiric blade set at a depth of 600 microns.3 Amesbury et al however said that “a PCRI depth of 450-550 microns is safe and effective, when used with a nomogram and pachymetry can be deferred in such cases.”6 In our study we used a steel blade set at a depth of 600 microns. Pachymetry was done for all patients. We did not encounter any complications like micro perforations or wound leak. Various studies advocate the performance of LRI at the beginning of phacoemulsification when consistent incision depth can be achieved in the presence of consistent intraocular pressure and to minimize epithelial disruption.5,7 Also Wang et al placed the PCRI at the conclusion of surgery and had a good success with this approach.2 They said that incisions placed early on have a greater effect but pose a greater risk of corneal perforation. We performed the LRI in the present study at the conclusion of phacoemulsification. An advantage of performing the incision at the conclusion of surgery is that these incisions can be omitted if there is some need to enlarge or change the site of cataract incision.

Conclusion

In conclusion, Limbal Relaxing Incision can reduce the pre existing astigmatism of mild to moderate degree of up to 1.00 D with predictable accuracy when combined with phacoemulsification. It is a safe, cost efficient procedure with low risk of complications and can be performed with ease.

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