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A prospective interventional comparison of astigmatism correction following straight and frown incisions in manual small incision cataract surgery

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Aim: Comparison of astigmatism correction following straight and frown incisions in manual small incision cataract surgery

Materials and methods: A prospective interventional cross-sectional study was conducted in the Department of Ophthalmology. 100 patients admitted for cataract surgery between the age group of 45 to 70 years were only considered for the study.

Results: The observation of astigmatism in diopters preoperatively revealed 48% had astigmatism -0.25 D, 36% has astigmatism range from 0.26 to 0.50 D, 14% had astigmatism range from 0.51 to 0.75 D, and 2% had astigmatism range from 0.76 to 1.00 D. The course of post-operative astigmatism in relation to preoperative status in patients with frown incision revealed majority showed shift toward WTR astigmatism in the first postoperative week, then the ATR astigmatism increases progressively up to 3 weeks and starts stabilizing at 3 weeks. However, in straight incision, the patients showed a shift toward WTR astigmatism at first postoperative week; then the ATR astigmatism increases progressively up to 3 weeks and stabilizes at 4 to 6 weeks. The best corrected visual acuity at 6 weeks of 6/9 or better following frown and straight SICS were 50 and 37% respectively, 1st week postoperatively; 77 and 53% respectively, 3rd week postoperatively; and 83 and 77% respectively, 6th week postoperatively. In our study, we found that frown incision had significantly better ($p < 0.001$) mean net astigmatism as compared with the straight incision.

Conclusion: We conclude that small incision size and absence of suture are the most important factors that contribute to less astigmatism and faster stabilization of SICS. The duration for stabilization of postoperative astigmatism in straight incision group is 6 weeks, whereas it is 3 weeks in frown incision.

Keyword: astigmatism, straight incision, small incision.

1. Introduction

Cataract is an eye condition in which the human crystalline lens becomes opaque and invariably affects vision [1–4]. It mostly affects the aged, but young people may suffer from congenital forms of the condition [1, 5, 6]. The causes and risk factors for cataract are many and varied. Some of them include genetics, sex, race, metabolic diseases, trauma to the eyes, radiation, use of certain drugs, and lifestyle [7, 8].

Sometimes, clinicians may also prescribe antioxidant-rich supplements and diets that are believed to retard the lens clouding process [9]. In spite of these approaches, vision is often improved when cataract is ultimately removed by surgery and patients undergo subsequent visual rehabilitation [3]. Surgical techniques for cataract extraction have undergone major advancement from intracapsular extraction to the present day phacoemulsification. Phacoemulsification offers desirable anatomical and functional results

following cataract surgery. The technique is however not widely used in some parts of the developing world for reasons such as higher cost and expertise. The most widely used surgical technique for cataract extraction in third world countries is the sutureless manual small incision cataract surgery (MSICS). MSICS is reportedly able to offer good anatomical and functional results following cataract surgery.

Materials and methods

A prospective interventional cross-sectional study was conducted among 100 patients admitted for cataract surgery between the age group of 45 to 70 years in the Department of Ophthalmology after taking the approval of the protocol review committee and institutional ethics committee.

Inclusion Criteria

- All patients who have a senile cataract in the age group of 45 to 70 years.
- Patients with no other cause for defective vision other than cataract.
- Patients with no history of previous ocular surgery in the operating eye.
- Preoperative astigmatism less than 1 D.

Exclusion Criteria

- Patients having operative complications (nucleus drop, posterior capsular rent) and systemic disorder (diabetes mellitus, hypertension).
- All patients with preoperative astigmatism of more the 1 D.
- Cases with premature entry.

Methodology

Preoperative assessment was done which included detailed history taking and routine investigations for intraocular surgery like recording of vision with Snellen's (or) E-chart, recording intraocular pressure with Schiotz tonometer, assessing the patency of duct, dilatation of pupil, refraction and fundus examination, preoperative keratometery with Bausch and Lomb keratometer. A scan biometry and intraocular lens (IOL) power calculation using SRK II (modified Sanders–Retzlaff–Kraff II regression) formula, slit lamp examination for anterior segment evaluation was done. Evaluation of status of other eye was done. Systemic parameters like postprandial blood sugar, systemic blood pressure, ear, nose, and throat and dental examination to rule out focal sepsis were done. All patients selected for surgery were admitted in the ward 1 day before surgery. The eyelashes were clipped and antibiotic drops were applied.

Surgical Procedure

Totally, 30 cases of each superior straight and superior frown incision SICS with PCIOL surgery were performed by a single surgeon at Pondicherry Institute of Medical Sciences, Puducherry, India. Informed consent was obtained from all the patients. These patients were taken up for comparative study.

After separating lids with a speculum and taking superior rectus bridle suture, a frown/straight incision 5.5 to 6 mm long (as measured by Castroviejo scleral caliper) in ½ thickness of sclera was made about 1.5 to 2 m posterior to limbus at 12 o'clock. The anterior chamber was deepened with viscoelastic. After completion of surgery and PCIOL implantation, a subconjunctival injection of 0.5cc gentamicin was given, followed by repositioning of conjunctiva over wound. No sutures were used to close the incision.

Patients who developed any complications arising during the surgery or during the postoperative period were excluded from the study.

Postoperative management and follow-up consisted of patients receiving a topical antibiotic steroid drop, which was tapered by 45 days. Patients were subjected to slit lamp examination on the first postoperative day and discharged on third postoperative day. The visual acuity and keratometry readings were taken on the day of discharge and at the follow-up period, i.e., at 1st week, 3rd week and 6th week postoperatively. The findings were tabulated on the specially prepared pro forma.

Surgically induced astigmatism (SIA) was calculated by scalar analysis method. In this method, SIA was calculated by subtracting the preoperative keratometric cylinder from that measured at each postoperative examination. Steep meridians between 46° and 134° were considered as with-the-rule (WTR) and those

with steep meridians less than 46° and greater than 134°, against the- rule (ATR). Preoperative or postoperative WTR cylinders were called positive; preoperative or postoperative
ATR cylinders were called negative. For example, an eye with 1 D of preoperative WTR cylinders that results in 1 D of postoperative ATR cylinders has been altered by a net 2 D astigmatism shift toward ATR.
The results were tabulated. Statistical analysis was done in EPI-Info software and t-test was applied. Statistical significance was taken as p-value < 0.0.05.

Results

In this study, 100 patients having senile cataract in the age group of 50 to 70 years were studied. Out of these majority were in the age group of 60 to 65 years (28%) and only 27% were more than 70 years. The male:female ratio was 1:1.
The profile of preoperative astigmatism revealed corneal astigmatism was not present in 28% patients. The WTR astigmatism was in 38% patients; ATR astigmatism was in 34% patients. The WTR was more frequent (Table 1).
The observation of astigmatism in diopters preoperatively revealed 48% had astigmatism 0.25 D, 36% has astigmatism range from 0.26 to 0.50 D, 14% had astigmatism range from 0.51 to 0.75 D, and 2% had astigmatism range from 0.76 to 1.00 D (Table 2). The course of post-operative astigmatism in relation to preoperative status in patients with frown incision revealed majority showed shift toward WTR astigmatism in the first postoperative week, then the ATR astigmatism increases progressively up to 3 weeks and starts stabilizing at 3 weeks. However, in straight incision, the patients showed a shift toward WTR astigmatism at first postoperative week; then the ATR astigmatism increases progressively up to 3 weeks and stabilizes at 4 to 6 weeks.
The best corrected visual acuity at 6 weeks of 6/9 or better following frown and straight SICS were 50 and 37% respectively, 1st week postoperatively; 77 and 53% respectively, 3rd week postoperatively; and 83 and 77% respectively, 6th week postoperatively. In our study, we found that frown incision had significantly better ($p < 0.001$) mean net astigmatism as compared with the straight incision (Table 3).
It has been noticed that the postoperative ATR astigmatism is common in frown and straight incision, which are both superior incisions.

Table 1: Types of preoperative astigmatism

Type of astigmatism	Frown incision	Straight incision	Total
WTR	20 (40%)	18 (36%)	38(38%)
ATR	19 (38%)	15 (30%)	34 (34%)
Neutral	11 (22%)	17 (34%)	28 (28%)
Total	50	50	100

Table 2: Range of astigmatism in diopters preoperatively

Range of diopters	Frown	Straight	Total
Nil–0.25	14 (28%)	34 (68%)	48 (48%)
0.26–0.5	26 (52%)	10 (20%)	36 (36%)
0.51–0.75	8 (16%)	6 (12%)	14 (14%)
0.76–1.00	2(4%)	–	2 (2%)
Total	50	50	100

Table 3: Mean astigmatism in diopters

	Frown	Straight
Mean net astigmatism	0.46	0.86
Standard deviation	±0.2264	±0.289

Discussion

In this study, 100 patients having senile cataract in the age group of 50 to 70 years were studied. Out of these majority were in the age group of 60 to 65 years (28%) and only 27% were more than 70 years. The male:female ratio was 1:1.
The profile of preoperative astigmatism revealed corneal astigmatism was not present in 28% patients. The WTR astigmatism was in 38% patients; ATR astigmatism was in 34% patients. The WTR was more frequent (Table 1).
The observation of astigmatism in diopters preoperatively revealed 48% had astigmatism -0.25 D, 36% has astigmatism range from 0.26 to 0.50 D, 14% had astigmatism range from 0.51 to 0.75 D, and 2% had astigmatism range from 0.76 to 1.00 D. To study the course of SIA, keratometry readings taken postoperatively at 1st week, 3rd week, and 6th week were considered.

For analyzing the net astigmatism, keratometry reading taken preoperatively and at 6th week only were considered.

The majority of the patients showed shift toward WTR astigmatism at first postoperative week and then the ATR astigmatism increases progressively up to 3 weeks then starts stabilizing at 3 weeks. As a result, low-grade astigmatism induced allows useful uncorrected visual acuity very early after surgery, while the stability in refraction achieved early after surgery permits early spectacle.

Gimbel *et al*. [10] concluded that there is a mean flatten- ing of the vertical steep meridian in sutured as well as nonsutured wound.

The majority of the patients showed a shift toward WTR astigmatism at first postoperative week; then the ATR astigmatism increases progressively up to 3 weeks, and stabilizes at 4 to 6 weeks. The initial high WTR astigmatism following SICS is due to following factors:

- Tissue edema, which persists in the immediate post- operative period, may cause wound compression, variation in intraocular pressure, and episcleral cautery.
- The WTR astigmatism following SICS decreases as the tissue edema subsides and as scleral relaxation occurs when the effect of cautery wears off.
- ATR shift occurs due to the mechanism of wound gaps. Gimbel and Sun [11] compared sutured with unsutured 5 to 6 mm frown incision and considered that in the short term, patients with preoperative WTR astigmatism may benefit from unsutured wound and those with preoperative ATR astigmatism may benefit from sutured wounds if the incision is placed in the vertical meridian.

Pfleger *et al*. [12] compared 3.5 and 4.5 mm sutureless self-sealing scleral tunnel with foldable IOL implantation. The SIA was less than 0.5 D in the early postoperative period and less than 0.25 D at 6 months postoperative in both groups, indicating that a 1 mm difference in size did not affect final astigmatism outcome. Immediately following surgery, there was a decrease in WTR astigmatism as well as a shift toward ATR astigmatism in both groups. The shift remained stable thereafter.

Olsen *et al.* [13] compared induced regular astigmatism and irregular astigmatism after scleral and corneal tunnel incisions on 100 phacomulsification patients with less than 1 D of preoperative astigmatism. The SIA was analyzed by vector analysis from keratometric data. They concluded that the clear corneal incision induces significantly more regular as well as irregular astigmatism than the scleral tunnel incisions.

In our study, we found that frown incision had significantly better ($p < 0.001$) mean net astigmatism as compared with the straight incision. This has also been concluded in a study by Singer [14]. These results suggest that the use of frown incision minimizes induced astigmatism after SICS.

Following studies also prove that the goal of minimizing postoperative SIA after cataract surgery and earlier stabilization can be achieved with frown incision A study done by Sinskey and Stoppel [15] concluded that mm no stitch frown incision induces low postoperative astigmatism and provides stable incision.

Deng and Liu [16] studied the impact of ECCE and phacoemulsification with 5 mm tunnel incisions or 7 mm frown-shaped incision on the postoperative visual acuity and corneal refractivity in 243 eyes and concluded that 7 mm frown incision of phacoemulsification was the most effective method to control postoperative astigmatism in cataract surgery.

This indicates the stabilization of SIA occurs at 3rd week itself in frown incision SICS than the straight inci- sion in SICS, which was stabilized only at 6 weeks.

The early and better unaided visual acuity following SICS procedure can be attributed to the less induced astigmatism and rapid stabilization of astigmatism following scleral tunnel procedures.

Conclusion

We conclude that small incision size and absence of suture are the most important factors that contribute to less astigmatism and faster stabilization of SICS. The duration for stabilization of postoperative astigmatism in straight incision group is 6 weeks, whereas it is 3 weeks in frown incision. Superior incision group (both frown and straight) had increased amount

of WTR astigmatism which later shifted to ATR. There was a significant difference in net astigmatism between frown and straight. Postoperative astigmatism also depends on preoperative astigmatism. Patients with preoperative WTR benefited from superior incision cataract surgery.

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