Original Article

Study of changes in pre-existing against-the-rule astigmatism after temporal manual small-incision cataract surgery using frown, straight, and smile incisions

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Purpose: To assess the change in the amount of astigmatism caused by frown, straight, and smile incision in patients with pre-existing against-the-rule (ATR) astigmatism of more than and equal to 1 diopter **Methods:** This is a prospective, comparative study conducted over 18 months on 60 patients. Twenty patients were allocated to each incision using simple random sampling. Demographic details, best-corrected visual acuity (BCVA), intraocular pressure (IOP), anterior and posterior segment evaluation, and A-scan were done. An average of three measurements of K horizontal (Khavg), K vertical (Kvavg), and difference between the two (Khavg − Kvavg) were taken using manual keratometry. All surgeries were performed by a single surgeon. All the data analyses were performed by using IBM Statistical Package for the Social Sciences (SPSS) version 20 software. Frequency distribution and cross tabulation were performed to prepare the tables. **Results:** In frown incision, Khavg − Kvavg was significantly decreased on day 45 from the preoperative value ($P < 0.001$), followed by straight incision ($P < 0.001$), and smile incision ($P < 0.001$). Maximum decrease was observed in frown incision (49.15%) followed by straight (37.75%) and smile (28.57%) incisions. **Conclusion:** Our results are consistent with reduction of pre-existing ATR astigmatism with temporal incisions, and frown incision seems to be the best approach.

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According to the World Health Organization (WHO), cataract is the leading cause of blindness all over the world. For large-scale surgeries, manual small-incision cataract surgery (MSICS) is a superior option.[1] A common reason for poor vision recovery after surgery is surgically induced astigmatism (SIA). MSICS are influenced by the location, size, and shape of the incisions. The SIA for temporal approach is smaller than the SIA for the superior technique.[2] One of the goals of modern cataract surgery is to reduce pre-existing astigmatism, a factor that may reduce visual acuity (VA) and affect the quality of vision.[3] The objective of this study was to determine the incision that gave the maximum reduction in pre-existing against-the-rule (ATR) astigmatism and postoperative best-corrected visual acuity (BCVA).

Methods

A prospective, comparative study was conducted at the ophthalmology department of a tertiary care hospital at Mysore, Karnataka, for 18 months. The study was conducted in accordance with the Declaration of Helsinki, and Institutional Ethical Committee clearance was obtained before initiating the study.

Sampling technique: Simple random sampling was used. The sample size was calculated as follows[4]:

$$N = (Za + Zb)^2 \times SD^2/d^2$$

$$= (1.96 + 0.84)^2 \times (1.02)^2/0.635 = 20$$

Za = 1.96, Zb = 0.84

The size of the effect that is clinically worthwhile to detect (d) = 0.635.

The standard deviation of the population being studied (SD) = 1.022.

The probability of falsely rejecting a true null hypothesis (a) = 0.05.

The probability of failing to reject a false null hypothesis (b) = 0.80.

Sample size = 20.

Patients

The source of data included all patients who attended the ophthalmology outpatient department (OPD) during the above-mentioned time. The total number of patients selected for this study were 60. The allocation of patients to frown incision, straight incision, or smile incision group was performed by simple random sampling [Figs 1 and 2].

Inclusion and exclusion criteria

Patients with nuclear cataracts of all grades (grades 1 to 4), cortical, mature, and hyper-mature cataracts having pre-existing

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ATR astigmatism were included in this study. Patients with co-existing ocular comorbidities were not included. Patients with intra- or postoperative complications were removed. Those patients with traumatic cataracts, complicated cataracts, cataracts with pterygium, corneal opacities, and previous corneal surgeries were excluded from this study. For those who met the inclusion criteria, a written, informed consent was obtained from all the patients before starting the study. All the risks associated with the study were well-communicated to all the patients in their local languages and consent was obtained.

Evaluation of the patients

The patients who were found eligible for the present study were subjected to following baseline evaluations:

- Snellen BCVA measurement
- Intraocular pressure (IOP) measurement using the Goldmann applanation tonometer
- Detailed anterior segment using slit lamp
- Detailed fundus examination
- Biometry including A-scan and keratometry for IOL power measurement
- The test was performed by a single person for the operating eye. Three measurements were obtained and the average measurement was obtained.
- The corneal morphology assessment was performed using a non-contact specular microscope. For the operating eye, three photographs were taken, and the average measurement was obtained.

Preoperative evaluation of the patient

All the patients for surgery underwent the following procedure in the preoperative period:

1. Trimming of the eye lashes
2. Lacrimal syringing
3. Topical eye drops: antibiotics and NSAID combination, that is, gatifloxaxin 0.3% instilled into the operating eye 1 hourly on the day prior to surgery
4. Consent for surgical procedure was taken.

Anesthesia

All SICS procedures were performed under peribulbar block or sub-Tenon's block.

Operative procedure

All surgeries were performed by a single surgeon. The size of the incision in each patient varied depending on the hardness and size of the nucleus from 6.5 to 7.5 mm. Rigid 6 mm IOL was used in all the patients. The incision site was temporal in all the three groups. The size of the scleral incision ranged from 6.5 mm to 7.5 mm depending on the hardness and size of the nucleus. The incision was made 1.5 mm away from the limbus with a 15 number blade. With a 3.2 mm angled keratome, the anterior chamber was entered 1.5 mm into the clear cornea. Internal incision was enlarged sideways up to 8.5 mm. A single piece intraocular lens (IOL) of 6 mm optic size and 12.5 mm total size was implanted into the bag.

Follow-up

Demographic details, BCVA, IOP, anterior and posterior segment evaluation, and A-scan were done. An average of three measurements of K horizontal (Khavg), K vertical (Kvavg), and the difference between the two (Khavg − Kvavg) were taken using manual keratometry. Every patient was followed up at postoperative day 1, day 7, day 30, and day 45, and all the outcome variables including keratometry readings were assessed for all the patients on each follow-up. Observer bias was removed as manual keratometry was done by the same surgeon before and after the surgery. Postoperatively, each patient was treated with tapering dose of moxifloxacin 5 mL/mg in combination with dexamethasone 1 mg eye drops and nepafenac 0.3% eye drops TID for three weeks.

Statistical analysis

All the data analyses were performed using IBM Statistical Package for the Social Sciences (SPSS) version 20 software. Frequency distribution and cross tabulation were performed to prepare the tables. Descriptive analysis was performed for obtaining baseline characteristics of the study cohort. Quantitative data was expressed as mean and standard deviation and categorical data was expressed as numbers and percentage.

Results

No significant difference was obtained in the mean age of all the three incision types. Mean age of patients who underwent

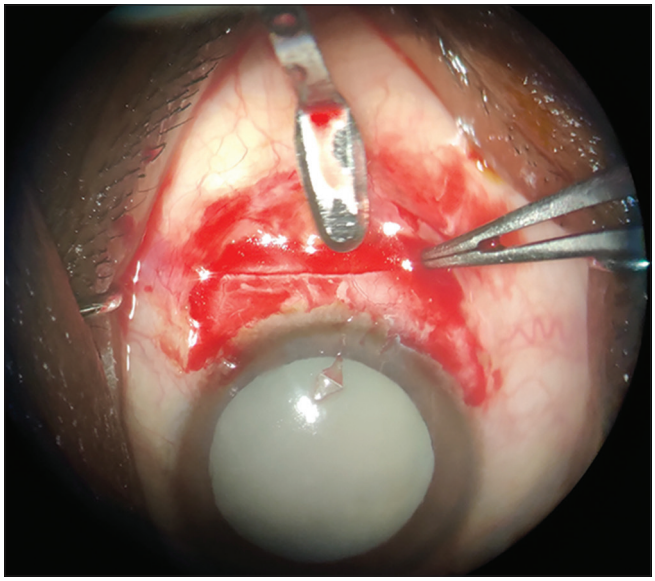


Figure 1: Temporal straight incision in MSICS

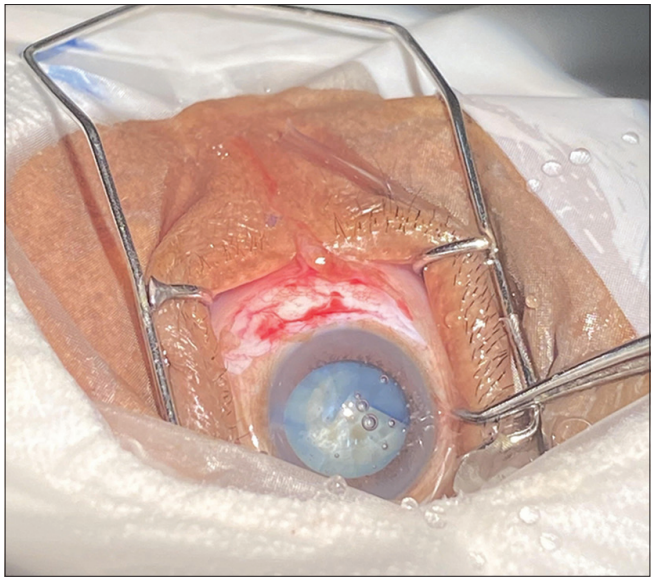
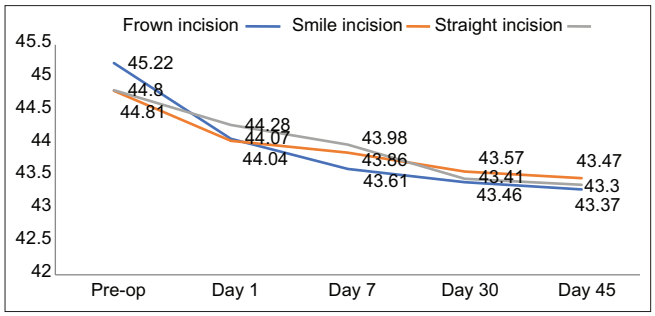
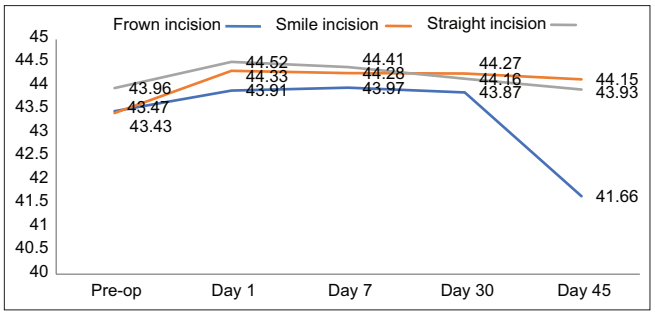


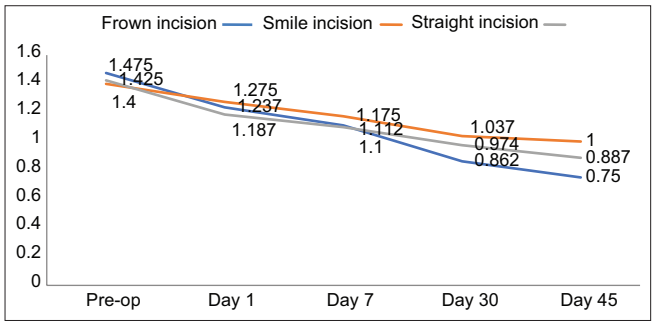
Figure 2: Temporal smile incision in MSICS



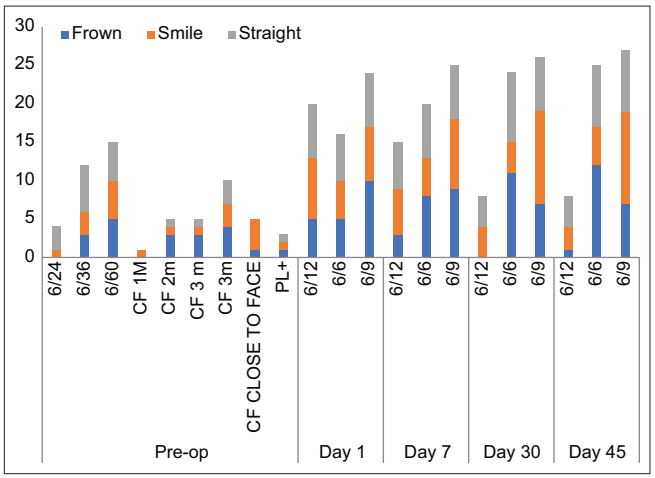
Graph 1: Graph comparing mean Khavg



Graph 2: Graph comparing mean Kvavg



Graph 3: Graph comparing mean Khavg – Kvavg



Graph 4: Graph comparing BCVA between incisions

frown, smile, and straight incision types was 66.55 ± 5.72, 67.8 ± 7.89, and 62.65 ± 8.06 years, respectively. The overall mean age of the study population was 65.66 ± 5.68 years.

No significant difference was observed in the gender distribution of all the incision types as revealed by the insignificant *P* value of 0.882. Similar reports were observed by Chourasia *et al*.[5] No Significant difference was observed in the eye involved between the three groups.

Maximum decrease in mean Khavg on final follow-up was observed in frown incision (4.24%) followed by straight (3.21%) and smile incisions (2.97%) [Table 1 and Graph 1].

On comparison of mean Kvavg between the incision types on final follow-up, maximum decrease was observed in frown incision (4.16%) followed by straight incision (0.068%), whereas smile incision led to an increase in Kvavg (1.67%) [Table 2 and Graph 2].

Maximum decrease of mean Khavg − Kvavg between incision types was observed in frown incision (49.15%) followed by straight (28.57%) and smile incisions (37.75%) [Table 3 and and Graph 3].

Upon comparing the BCVA of the three incisions, it was found that in frown incision the majority (60%) achieved 6/6 vision (*P* = 0.011) compared to straight (40%; *P* = 0.028) and smile (25%; *P* = 0.023) incisions [Graph 4].

Discussion

Most cataract patients in underdeveloped nations may have preoperative ATR astigmatism due to the prevalence of senile cataracts and the ATR shift in astigmatism with age.[6] For these patients, the amount of postoperative corneal astigmatism might be influenced by the position of the incision. In the present study, no significant difference was observed in the eye involved as well as the gender distribution in the three groups.

Maximum decrease in mean Kvavg was observed in frown incison (4.16%) followed by straight incision (0.068%), whereas smile incision led to an increase in Kvavg (1.67%). Sekharreddy *et al*.[7] reported findings similar to the present study, with superotemporal scleral incision and temporal scleral incision. In line with the present study, Reddy *et al*.[8] reported that in SICS with different incisions, temporal incision induced the least amount of net cylinder when compared to other types of incisions. Therefore, to avoid a high SIA in MSICS, a temporal incision or a superior frown incision is the best preferred incisions. However, in the present study we found frown incision to be better.

In the present study, in the frown incision group the majority (60%) achieved 6/6 vision (*P* = 0.011) compared to the straight incision group (40%; *P* = 0.028) and the smile incision group (25%; *P* = 0.023); all three groups showed significant improvement in postoperative visual acuity. One of the factors that decide the uncorrected postoperative visual acuity is SIA.[9] However, SIA does not have a direct bearing on the unaided postoperative visual acuity as this will depend on the preoperative magnitude and vector of the astigmatism.[10]

In the present study, 89.50% of patients in the straight incision group, 94.7% in the frown incision group, and 95.20% in the smile incision group had BCVA of at least 6/18 or better at four weeks postoperatively. Only 6.86% of patients had BCVA less than 6/18, which was attributed to macular edema in one patient, drusens at macula in one patient, vitreous in the anterior chamber in one patient, and thick fibrinous

Table 1:Khavg among the three groups preoperatively and on follow up day 1, day 7, day 30 and day 45

Khavg	Incision			Overall mean
	Frown	Smile	Straight	
Pre-op	45.22	44.8	44.81	44.94
Day 1	44.07	44.04	44.28	44.13
Day 7	43.61	43.86	43.98	43.82
Day 30	43.41	43.57	43.46	43.48
Day 45	43.3	43.47	43.37	43.38
Percentage decrease compared to pre op	4.24	2.97	3.21	
P	0.012	0.011	0.023	

Table 2:Kvavg among the three groups preoperatively and on follow-up day 1, day 7, day 30 and day 45

Kvavg	Incision			Overall mean
	Frown	Smile	Straight	
Pre-op	43.47	43.43	43.96	43.62
Day 1	43.91	44.33	44.52	44.25
Day 7	43.97	44.28	44.41	44.22
Day 30	43.87	44.27	44.16	44.12
Day 45	41.66	44.15	43.93	43.25
Percentage decrease compared to pre op	4.16	-1.67	0.068	
P	0.001	0.246	0.121	

Table 3:Khavg-Kvavg among the three groups preoperatively and on follow-up day 1, day 7, day 30 and day 45

Khavg-Kvavg	Incision			Overall mean
	Frown	Smile	Straight	
Pre-op	1.475	1.4	1.425	1.433
Day 1	1.237	1.275	1.187	1.233
Day 7	1.112	1.175	1.1	1.129
Day 30	0.862	1.037	0.974	0.957
Day 45	0.75	1.00	0.887	0.879
Percentage decrease compared to pre op	49.15	28.57	37.75	
P	<0.001	<0.001	<0.001	

membrane over the IOL in another patient. Jauhari *et al*.[11] in their study on 2000 eyes undergoing MSICS found that 93.4% of eyes achieved a final BCVA better than 6/12 at six weeks, postoperatively. Ninety-three point three percent of patients had BCVA of 6/18 or better at eight weeks after SICS with central frown incision.

Rohatgi[12] discovered that 93.3% of patients had a BCVA of 6/18 or better at eight weeks after SICS with central frown incision. Contrary to the findings of the present investigation, a study by Satyajeet Pawar and Sindal[13] found that temporal incision caused less astigmatism than superotemporal incision. However, the difference was not statistically significant.

Limitations

Small sample size and short duration of follow-up are limitations of the present study.

Conclusion

Cataract is one of the most common causes of preventable blindness. Cataract surgeries are nowadays considered as refractive surgeries since visual acuity is of utmost importance. A variety of scleral incisions are being used in manual small-incision cataract surgery to reduce pre-existing astigmatism. Our results are consistent with the reduction of the same in temporal incisions, and frown incision seems to be the best approach.

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Conflicts of interest

There are no conflicts of interest.

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