A COMPARISON OF SURGICALLY-INDUCED ASTIGMATISM BETWEEN PHACOEMULSIFICATION WITH SUPERIOR INCISION AND SMALL INCISION CATARACT SURGERY WITH STEEP AXIS INCISION

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ABSTRACT

BACKGROUND

The recent years have seen a huge increase in the burden of cataract surgery in India along with a decreased tolerance for spectacles in patients after cataract surgery. These changing trends have made it essential for each surgeon to strive for the ultimate goal of postoperative emmetropia by minimising the Surgically-Induced Astigmatism (SIA). One of the main factors influencing SIA is the type of cataract surgery due to the differences in their incision size. Presently, both Small Incision Cataract Surgery (SICS) and phacoemulsification are widely practised all over our country. Such a scenario makes it relevant to compare the two surgeries and adopt the one with better visual outcome in order to keep up with patient expectations. In our study, we aimed to compare the magnitude of postoperative SIA and Best Corrected Visual Outcome (BCVA) between SICS and phacoemulsification. Moreover, while all phaco surgeries were performed using a superior clear corneal incision, all SICS cases used an incision on the steeper axis.

MATERIALS AND METHODS

300 operable cataract patients (<grade 3 nuclear sclerosis) with preoperative astigmatism less than 3D were divided into two groups of 150 patients each. Group A underwent phacoemulsification with superior clear corneal incision, while group B underwent SICS with incision along the steeper meridian. BCVA and keratometry were measured 12 weeks after surgery. The keratometry values were inputted into SIA calculator (version 2.1) and the resultant SIA was found.

RESULTS

The mean SIA in group A (0.7793 ± 0.445) was significantly less ($p<0.0001$) than that in group B (1.6887 ± 1.473). The postoperative BCVA was also significantly better ($p<0.0001$) in group A than in group B. Moreover, the SIA was independent of the age of the patient, but was significantly correlated with the BCVA. The more the postoperative SIA, the poorer was the BCVA.

CONCLUSION

Even when the incision is made in the steeper meridian in SICS, it induces significantly more astigmatism than phacoemulsification with superior incision.

KEYWORDS

SIA (Surgically-Induced Astigmatism), BCVA (Best Corrected Visual Outcome), Phacoemulsification, SICS (Small Incision Cataract Surgery).

HOW TO CITE THIS ARTICLE: Sarkar S, Nag A, Biswas S, et al. A comparison of surgically-induced astigmatism between phacoemulsification with superior incision and small incision cataract surgery with steep axis incision. J. Evid. Based Med. Healthc. 2018; 5(4), 310-314. DOI: 10.18410/jebmh/2018/62

BACKGROUND

Senile cataract is a major cause of blindness throughout the world. In India, it is reportedly responsible for 50-80% of bilateral blindness.[1] Recent data from World Health Organization (WHO) shows a 25% decrease in blindness prevalence in India. This can be attributed to the increase in number of cataract surgeries (3.9 million per year in 2003 as compared to 1.2 million per year in 1980).[2-4] It was also predicted that the Indian population aged >60 years would double by 2016 from the 56 million in 1991.[5] This population boom has immensely raised the burden of cataract surgery in India.

In terms of surgical outcome, cataract surgery is the most cost effective of all surgical interventions.[6,7] However, it has some unavoidable complications, one of the most important among them being Surgically-Induced Astigmatism (SIA). Astigmatism is a refractive error where the curvature (and hence, dioptric power) varies in different

Financial or Other, Competing Interest: None.
Submission 31-12-2017, Peer Review 05-01-2018,
Acceptance 16-01-2018, Published 18-01-2018.
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DOI: 10.18410/jebmh/2018/62

meridian, so that rays of light cannot converge to a point focus, but form focal lines.[8,9] Factors affecting SIA in cataract surgery are-

1. Nature of Incision- Size, site and configuration of wound.
2. Scleral cauterisation.
3. Use of topical steroids.
4. Suturing.

Clearly, the type of cataract surgery performed is a major factor governing the postoperative SIA. Currently, Small Incision Cataract Surgery (SICS) and phacoemulsification (phaco) are both widely practised all over India. Phaco needs more technical expertise and is a costly modality for the common mass, whereas SICS is an inexpensive alternative with comparable visual outcome. In the present scenario, SICS is largely practised in government hospitals, which have a tremendous load of cataract patients. But, phaco is now being increasingly preferred and not just because of its basic advantage of a smaller incision. In fact, it has been reported that irrespective of the site of incision, phaco results in lesser astigmatism and improved visual outcome with better quality of life.[10]

In today's world of new technologies and advanced techniques, there is a decreased tolerance for postoperative astigmatism with some patients even expecting spectacle independence after surgery. It is therefore imperative that surgeons do their utmost to control the astigmatism in surgical setting. An important step for each surgeon or institution would be to compare the SIA between the two available surgical techniques and then adopt the better technique where possible.

In our study in a tertiary hospital, we aimed to compare the magnitude of SIA produced between a 6.5 mm scleral frown incision along the steeper meridian in SICS and a 2.8 mm superior clear corneal incision in phaco. The findings of our study are extremely relevant in the present scenario where each surgeon must strive to perform more precise surgery in order to minimise SIA and attain the goal of emmetropia.[11,12]

MATERIALS AND METHODS

This was a prospective, comparative and interventional hospital-based study conducted over one year from April 2015 to March 2016 in a tertiary care centre. Out of all patients attending the outpatient department, 300 patients with uncomplicated senile cataract up to grade 3 nuclear sclerosis were enrolled in the study.

We excluded all cases of congenital, developmental, complicated and traumatic cataracts. Eyes with pterygium or corneal opacity were excluded as were those which had undergone previous ocular surgery like refractive surgery, retinal detachment surgery, glaucoma surgery, squint correction or keratoplasty. Myopia >6D, hypermetropia >3D and preoperative corneal astigmatism >3D were also excluded from the study.

Patients who met the inclusion and exclusion criteria signed the informed consent after being explained the study protocol. Ethics committee approval for the study was taken beforehand.

A detailed history-taking and clinical examination for anterior and posterior segment were done. Routine preoperative assessment and all mandatory investigations for cataract surgery were carried out including Best Corrected Visual Acuity (BCVA), cardiology check-up, fasting blood glucose, lacrimal syringing and A-scan biometry.[13] Biometric information, i.e. keratometric readings and axial length of the eye were used to calculate IOL power by modified SRK II formula.[14]

Keratometry was the pivotal investigation in our study. It was performed twice: preoperatively and again 12 weeks postoperatively. We used Bausch and Lomb keratometer, which works on the principle of constant object size and variable image size.[15-17]

Patients were randomly divided into two groups, A and B, of 150 patients each, who underwent phacoemulsification and SICS, respectively. On the day of surgery, pupils were dilated with 0.8% tropicamide and 5% phenylephrine eyedrops and surgery was performed under peribulbar anaesthesia (lignocaine hydrochloride 2% + adrenaline (1 in 2,00,000) + hyaluronidase 1500 IU/mL).

In group A, a 15° side port blade was used to make 2 side ports measuring 1.5 mm about 2-3 clock hours on either side of the main port. First a Continuous Curvilinear Capsulorhexis (CCC) was done using a 26G cystitome through the side port under viscoelastic cover with trypan blue capsular staining. A superior clear corneal incision was made with a 2.8 mm keratome and anterior chamber entered in a triplanar manner. Hydrodissection and hydrodelineation was done and nucleus was rotated freely in bag. Phaco probe was then introduced and using standard phaco techniques of chopping and 'flip and chip', the nucleus and epinucleus were removed. Cortical matter wash was given using irrigation-aspiration cannula and foldable IOL implanted in bag using injector system. All ports were hydrated.

In group B, after peritomy (fornix based) and light wet-field bipolar cautery, a 6.5 mm frown incision was made 2 mm from the limbus on the steepest meridian (calculated by preoperative keratometry). A 2.8 mm crescent blade was used to create a self-sealing sclerocorneal tunnel extending into the clear cornea for 1 mm. CCC was then done in the same manner as in group A. Anterior chamber was entered through the tunnel using a 3.2 mm keratome. Hydrodissection was done and the prolapsed lens delivered out using wire vectis. Irrigation and aspiration of any remaining cortical lens matter was done using Simcoe byway cannula. A rigid IOL was implanted in the capsular bag and dialled. The self-sealing wound was then left without suturing after checking for any wound leakage.

At the end of both surgeries, subconjunctival injection of 0.25 mL gentamycin (40 mg/mL) and 0.25 mL dexamethasone (4 mg/mL) was given and a sterile eye pad placed.

Patients with any intraoperative complications like excess cautery, iridodialysis, premature tunnel entry,

capsular rent, nucleus drop or postoperative complications like iris prolapse, etc. were excluded from the study.

Routine postoperative eyedrops were prescribed and regular follow-ups done. The BCVA and keratometry readings were taken postoperatively at 12 weeks. The amount of postoperative SIA was calculated using SIA calculator version 2.1.

Statistical analysis was done by SPSS (version 20.0.1) and GraphPad Prism (version 5). A p-value <0.05 was considered statistically significant.

RESULTS

Of the 300 patients in this study, 35.3% were females and 64.7% were males. The mean age of patients was 55.2 ± 6.46 years and maximum number of patients (46.7%) belonged to the age group of 51-60 years. There were no significant differences between groups A and B regarding age or gender.

The mean SIA in group A (0.7793 ± 0.445) was significantly less (p<0.0001) as compared to that in group B (1.6887 ± 1.473). This indicates that even when the incision is made in the steeper meridian in SICS, it induces more astigmatism than phaco with superior incision (Table 1).

The postoperative BCVA at 12 weeks was also significantly better (p<0.0001) in group A as compared to group B. 50 patients of group A attained BCVA of 6/6, while only 13 patients did so in group B. While none in group A attained BCVAs of 6/24 and 6/36 in group B, 9 and 7 patients did so. Clearly, better BCVA was attained by those who underwent phaco as compared to those who underwent SICS (Table 2).

Furthermore, we found no significant relation between mean SIA value and age distribution of patients of the two groups indicating that the SIA value is independent of the age of the patient (Tables 3, 4).

On the other hand, there was a significant relation (p<0.0001) between the distribution of mean SIA and BCVA in both the groups. More the mean SIA value, poorer is the BCVA acquired in the postoperative period (Tables 5, 6).

Group	Number	Mean	Standard Deviation	Minimum	Maximum	Median
A	150	0.7793	0.4459	0.0000	3.0000	0.6000
B	150	1.6887	1.4733	0.0000	9.0000	1.5000

Table 1. Distribution of Mean SIA (Week 12) in Groups A and B

T-test; p<0.0001.

BCVA	A	B
6/6	50	13
6/9	66	36
6/12	30	53
6/18	4	32
6/24	0	9
6/36	0	7
Total	**150**	**150**

Table 2. Distribution of BCVA (Week 12) in Groups A and B

Chi-square- 74.7050; P-value- <0.0001.

Age (Years)	Number of Patients	Mean	Standard Deviation	Minimum	Maximum	Median	P value
≤50	44	0.8023	0.4417	0.0000	1.6000	0.6000	0.8533
51-60	74	0.7811	0.4704	0.0000	3.0000	0.6000	
>60	32	0.7438	0.4024	0.1000	1.6000	0.6500	

Table 3. Distribution of Mean SIA and Age in Group A

Age (Years)	Number of Patients	Mean	Standard Deviation	Minimum	Maximum	Median	P value
≤50	33	1.3848	1.2983	0.0000	6.0000	1.0000	0.1163
51-60	66	1.9636	1.7416	0.0000	9.0000	1.5000	
>60	51	1.5294	1.1225	0.0000	6.0000	1.5000	

Table 4. Distribution of Mean SIA and Age in Group B

BCVA	Number of Patients	Mean	Standard Deviation	Minimum	Maximum	Median	P value
6/6	50	0.5520	0.3131	0.0000	1.2000	0.5000	<0.0001
6/9	66	0.7727	0.4629	0.0000	3.0000	0.6000	
6/12	30	1.1167	0.3687	0.5000	1.6000	1.1000	
6/18	4	1.2000	0.2828	1.0000	1.6000	1.1000	

Table 5. Distribution of Mean SIA and BCVA in Group A

BCVA	Number of Patients	Mean	Standard Deviation	Minimum	Maximum	Median	P value
6/6	13	0.1692	0.3146	0.0000	1.1000	0.0000	<0.0001
6/9	36	0.6333	0.3610	0.0000	1.6000	0.5000	
6/12	53	1.4811	0.5781	0.5000	2.8000	1.5000	

6/18	32	2.5813	0.9000	1.0000	5.1000	2.5000	
6/24	9	3.3556	2.2165	1.7000	9.0000	3.0000	
6/36	7	5.2857	1.9334	2.5000	8.5000	5.5000	

Table 6. Distribution of Mean SIA and BCVA in Group B

DISCUSSION

The purpose of our study was to compare both SIA and BCVA between phacoemulsification (with superior clear corneal incision) and SICS (with steeper meridian incision) at 12 weeks postoperatively. Postoperative keratometry was done at 12 weeks because SIA usually gets stabilised by that period.[18]

Maximum number (46.7%) of our study subjects belong to the age group of 51-60 years similar to results obtained by Haroon Awan et al.[19] This demonstrates the increasing trend of seeking early surgical intervention in our country. However, only 35.3% of our patients were females revealing a possible gender bias in our society in seeking eye care.

The mean SIA in our phaco patients (0.7793 ± 0.445D) was lesser than that obtained by Kagnici et al (0.94 ± 0.47D), but greater than that obtained by Latha et al (0.60D) or Zheng et al (+0.49D).[20-22] The mean SIA of our SICS patients (1.68 ± 1.4 D) was similar to that of Malik et al (1.45 ± 0.73 D) who used a superior incision, but greater than that of Vinay et al (0.487 ± 0.35 D) who used a superotemporal incision.[23,24] From the above studies, it is evident that there exists wide variations in the reported SIA values from different regions. These differences can be attributed to variations in surgical technique as well as different periods of postoperative follow-up. Ultimately, each institution or solo practitioner must establish their own normative range of acceptable SIA and strive to achieve it in every surgery. The data from our study would be invaluable in this regard.

At 12 weeks, we found significantly less SIA and consequently, significantly better BCVA in those who underwent phaco as compared to SICS. This indicates that even when the incision is made in the steeper meridian, SICS induces more astigmatism as compared to phaco with a superior incision. Clearly, other factors like smaller incision length in phaco or use of cautery in SICS have a significant impact on postoperative astigmatism and visual outcome. Moreover, the surgeries were performed by either of two surgeons and the intersurgeon variability is also expected to have a bearing on the SIA. More accurate results can be obtained by ensuring that a single surgeon performs all the surgeries. Moreover, instead of using superior clear corneal incisions in phaco, a subsequent comparative study can be carried out with steeper meridian incisions in both the SICS and phaco groups. A longer follow-up period may also be useful in revealing any changes in astigmatism over time.

CONCLUSION

SICS currently remains the preferred method of surgery in most government hospitals who are plagued with a huge burden of cataracts. However, the growing expectations of patients is prompting a change in this trend. In today's modern life, patients expect clearer vision and less dependence on spectacles post cataract surgery. To attain this goal of maximum uncorrected visual acuity, SIA needs to be minimised as much as possible by adopting the best available surgical technique. Our results clearly establish phacoemulsification as the procedure of choice. It not only gives a better visual outcome with minimal SIA, but also provides earlier rehabilitation. Adequate resources and hands-on phaco training for all surgeons is the need of the hour to achieve the goal of emmetropia after cataract surgery.

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