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Postoperative astigmatism after small-incision cataract surgery with sclera tunnel suturing and without scleral tunnel suturing: A comparative study

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Abstract

Background and aim

Cataract represents a significant socioeconomic burden and a public health concern, as it is the leading cause of blindness worldwide. Small-incision cataract surgery (SICS) is one of the cataract surgical techniques commonly used in developing countries. There have been many improvements and changes in SICS's technique since its development, including changes in the site and size of the incision.

Patients and methods

This study was conducted aiming to study postoperative astigmatism after SICS with or without scleral tunnel suturing. This study was performed on 100 eligible eyes in 59 consecutive patients. Identical surgical methods were used in all cases except for wound closure technique as patients were allocated into two groups, where SICS was performed with scleral tunnel suturing in the group A and without scleral tunnel suturing in the group B. Patients were assessed preoperatively and were followed up for 3 months.

Results and conclusion

The study revealed a highly statistically improvement in visual acuity at 3 months postoperatively in both groups. Meanwhile, SICS performed either with or without scleral tunnel suturing was not associated with significant preoperative and postoperative astigmatism changes. In addition, in terms of postoperative visual acuity or refraction, no statistically significant differences were observed between the two classes. Therefore, according to anterior chamber's stability and close closure of the scleral tunnel and conjunctival wounds, it is a case-specific situation and acceptable for each case.

Keywords: cataract, scleral tunnel suturing, small-incision cataract surgery, surgically induced astigmatism

Introduction

Small-incision cataract surgery (SICS) is one of the cataract surgical techniques commonly used in developing countries [1]. It is a low-cost, small-incision form of extracapsular cataract extraction (ECCE) [2].

SICS is characterized by early wound stability, less postoperative inflammation, no complications associated with sutures, few postoperative visits, and less damaging corneal endothelium effects [3]. Outcomes using small-incision techniques have been encouraging in settings where large volumes of surgery have been undertaken [4].

The basic technique of SICS has considered a sutureless and self-sealing incision. Moreover, since SICS's development, there have been many changes and modifications in SICS's technique. Some of these significant modifications are [5] mini-Nuc technique, in which an anterior chamber (AC) maintainer is used in ECCE along with a reduction in incision size, which keeps the eye in a normotensive state throughout

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the surgery [6]. At 2 mm posterior to the limbus, a 6.5–7-mm superior straight scleral tunnel incision is made. Two side ports are created at 6 and 9 o'clock position, and an AC self-retaining maintainer is placed, and continuous curvilinear capsulorhexis is performed. Hydrodissection, nucleus manipulation, the cortex's aspiration, and dialing of intraocular lens (IOL) in the bag are performed after the AC maintainer is removed. In Ruit technique, a 6.5–7 mm temporal scleral tunnel with a straight incision is created 2 mm from the limbus. A side point incision is made, and V-shaped capsulotomy (capsulorhexis) is done. After hydrodissection, the nucleus is delivered by visco-expression. The remaining cortex is aspirated, and IOL is implanted in the capsular bag [5]. Malik's technique is a modified SICS technique aiming to prevent corneal endothelial cell loss [7]. It is an easy maneuver by an assistant during nuclear delivery to continuously infuse 2% hydroxymethyl cellulose via the AC maintainer. This can be merged with any SICS system. For manual SICS, a double-nylon loop in which the lens is split into three parts so that the incision can be small, 4.0–5.0 mm, and sutureless, allowing a foldable IOL to be inserted. The double-nylon loop is made of 4-0 nylon threaded through a blunt tip needle of 20 G and can be reused several times. This approach is less costly and ideal for use in developed nations [5].

The intraoperative and postoperative complications and the occurrence of surgically induced corneal astigmatism are the main factors influencing the visual acuity following SICS. Surgically induced changes in corneal morphology mainly cause postoperative surgically induced astigmatism (SIA), changes in corneal refraction, and refractive index [8]. SIA is affected by the location, shape, and size of incisions used in SICS. Temporal approach results in smaller SIA than a superior approach. In addition, in contrast with medium (6.5 mm) and wide (7 mm) incisions, small incisions (6 mm) have been found to cause the smallest SIA. As compared with straight and frown incisions, the chevron-shaped incision has also been documented to offer minimal SIA [9]. SIA is also very minimal after sutureless corneal incision. If the incision is positioned on the steepest meridian, it is possible to greatly minimize corneal astigmatism postoperatively [10]. With optical correction, suture manipulation, or refractive surgery, correction of astigmatism is possible [11]. Removal of sutures at 12 weeks postoperatively results in a comparatively stable refractive state of the eye and can thus prevent regular glass changes [12]. SICS provides better results compared with ECCE and provides results just as good as phacoemulsification, while being quicker, cheaper, and less technology dependent [13], and it is associated with faster visual recovery [14].

SICS has gained widespread popularity as a safe method for cataract surgery, especially among poor patients in developing countries. This is because of its low cost, fair speed, cheap machinery with cheap maintenance, shorter learning curve, and appropriateness for mature and intumescent cataracts [15]. However, SICS has also been associated with various corneal complications such as endothelial damage, Descemet's membrane detachment, epithelial toxicity and disruption, infections, sterile corneal ulceration, stromal melt, vitreous touch with damage to the endothelium, and epithelial ingrowth [15].

Aim

This study was conducted aiming to study postoperative astigmatism after SICS with or without scleral tunnel suturing.

Patients and methods

The approval of the study protocol was obtained from our institute's Institutional Review Board. Before data collection, administrative approval and official permits were obtained. Informed consent was obtained from patients involved in the study on the basis of a data confidentiality guarantee.

Time frame

This study was conducted during the period from March 2018 to February 2020.

Study population

This study was conducted on 100 eligible eyes in 59 consecutive patients who attended the ophthalmology outpatient clinic of Sohag Teaching Hospital during the study period.

Inclusion criteria

The following were the inclusion criteria:
(1) Senile cataract.
(2) Eligible for SICS.

Exclusion criteria

The following were the exclusion criteria:
(1) Patients with dense cataracts (preoperative astigmatism cannot be assessed).
(2) Patients with high myopia (thin sclera) or high hypermetropia (shallow AC).
(3) Patients with glaucoma (shallow AC, need for further glaucoma operation).
(4) Patients with old bleb-forming glaucoma operation.
(5) Patients with low endothelial cell count.
(6) Patients with chronic uveitis.
(7) Patients with diabetic retinopathy.
(8) Patients with unhealthy conjunctiva or autoimmune cicatricial diseases.
(9) Patients with rubeosis iridis.
(10) Patients with old penetrating trauma.

Patients were allocated into two groups:
(1) Group A: 50 eyes, for whom SICS was performed with scleral tunnel suturing.
(2) Group B: 50 eyes, for whom SICS was performed without scleral tunnel suturing.

Methods

Cases were assessed preoperatively. History taking included detailed medical history and detailed ocular history, including duration of symptoms, myopia, trauma, previous anterior segment operations (glaucoma surgery), and previous posterior segment procedures (laser photocoagulation, previous intravitreal or subtenon injection, or previous vitrectomy). Visual acuity was evaluated by nonaided and aided method after correction of refraction errors using ETDR charts, and error of refraction was estimated by auto-refractometer. Anterior segment examination was performed using slit-lamp with IOP measurement by slit-lamp mounted applanation tonometer for assessment of the integrity of cornea stroma and endothelium, depth of AC, the integrity of uveal tract (iris, ciliary body, and angle), state of the anterior and posterior lens capsule, grading of cataract, and assessment of lens zonules. Detailed fundus examination (if it can be seen) was performed by indirect ophthalmoscope using 20 D lens and scleral indentation with a thimble depressor and slit-lamp biomicroscopy by 78 D lenses with the assessment of the following: integrity of retinal vasculature, the integrity of retinal background, macular status, posterior vitreous face status, retinal or choroidal detachment, and choroidal effusion.

The procedure was started following general or local anesthesia, followed by sterilization with 'betadine' for the eyelids, the skin around, and 'betadine' eye drops for the conjunctival cul-de-sac. Sterile drapes were applied, followed by conjunctival dissection fornix-based manner up to 10 mm width, with dissection from underneath sclera and tenon up to 5 mm length (limbal peritomy). Subconjunctival bipolar cauterization was performed for any bleeders followed by scleral horizontal wound scratch from 2 to 2.5 mm from limbus with 6–7 mm length. Scleral lamellar tunnel dissection was performed using a crescent knife up to clear cornea with inside width up to 10 mm without AC opening. Nasal or temporal paracentesis (according to the eye operated eye right or left) was performed with MVR 20 G followed by anterior capsule staining with sterile intracameral trypan blue stain through paracentesis under air, followed by balanced saline solution (BSS) washing. Viscoelastic was injected to fill AC, and wide continuous curvilinear capsulorhexis was done (6–7 mm). Hydrodissection and hydrodelineation were performed with BSS to dissect and dislodge nucleus and epi-nucleus from capsular bag and rotate it with viscoelastic to be in AC. The cornea was opened through a scleral tunnel with keratome at the same way of dissection, and the nucleus was delivered with scoop and IOL dialer (Sandwich technique). This was followed by irrigation and aspiration with BSS for epi-nucleus and cortical matter through scleral tunnel and side Porte corneal tunnel. Viscoelastic was used to fill AC and capsular bag, and hard PMMA (6.5 mm) IOL was implanted in the capsular bag. Irrigation and aspiration for viscoelastic were performed after IOL implantation, and an air bubble was injected in AC through the side port. Scleral tunnel wound was sutured with three sutures of 10/0 Nylon silk in group A, followed by massaging, and testing of AC stability without suturing in group B. Conjunctival massaging and gentle traction were performed to cover the scleral tunnel with or without suturing or cauterization of its peripheral corners to become sticky adherent to the sclera. Stromal hydration to corneal side opening was performed with BSS, and the procedure was ended by sterile eye patching.

Patients were followed up 1 day postoperatively and at 1 week, 2 weeks, 1 month, and 3 months postoperatively. Follow-up was performed in the same way as preoperative assessment, that is, evaluation of visual acuity, corneal integrity, anterior segment examination, conjunctival and scleral tunnel examination, AC depth, reaction, IOL assessment, stability, IOP assessment, and postoperative refraction measurement using an auto-refractometer.

Statistical analysis

Data were collected, revised, coded, tabulated, and analyzed using Statistical Package for Social Science (IBM SPSS, IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.) version 20. Data were described as numbers and percentages for the qualitative data, and mean, SDs, and parametric distribution ranges for the quantitative data. To compare groups with quantitative data, an independent *t* test was used, a χ^2 test was used to compare groups with qualitative data, and a paired *t* test was used to compare two groups with quantitative data before and after results. The confidence interval was set at 95% and the agreed error margin was set at 5%. So, at the level of less than 0.05, the *P* value was considered to be important.

Results

A review of patients' demographic and clinical characteristics in the two groups revealed that the mean age of patients was 61.93 ± 7.81 years in group A and 62.67 ± 6.64 years in group B. Among patients in group A, 44.8% were males and 55.2% were females, whereas in group B patients, 40% were males and 60% were females, and no statistically significant differences were found between both groups regarding age and sex. The mean preoperative visual acuity was slightly and significantly higher in group B patients compared with group

Table 1: Demographic and preoperative clinical characteristics of patients in the two groups

	Group A (sutured)	Group B (sutureless)	Test value	*P*
Age (years)				
Mean±SD	61.93±7.81	62.67±6.64	−0.390[a]	0.698
Range	33:76	49:74		
Sex [*n* (%)]				
Male	13 (44.8)	12 (40.0)	0.141[b]	0.708
Female	16 (55.2)	18 (60.0)		
Preoperative visual acuity				
Mean±SD	0.09±0.03	0.11±0.03	−2.182[a]	0.033
Range	0.03:0.16	0.06:0.16		
Preoperative refraction				
Mean±SD	−1.53±0.76	−1.60±0.87	0.360[a]	0.720
Range	−3 to−0.5	−3 to−0.5		

[a]Independent test. [b]χ^2 test.

A patients. Meanwhile, the mean preoperative refraction was comparable among patients in both groups (Table 1).

Comparing preoperative and postoperative clinical characteristics of patients in the two groups revealed a statistically significant visual acuity at 3 months postoperatively in both groups. However, postoperative refraction change compared with its preoperative value was not statistically significant in group A or group B (Table 2).

A review of follow-up results in the two groups revealed gradual improvement in postoperative visual acuity over time. However, a comparison of postoperative follow-up results in the two groups revealed no statistically significant differences between both groups regarding a postoperative second week, first, second and third-month visual acuity or postoperative refraction (Table 3 and Figs. 1–3).

Discussion

Cataract represents a significant socioeconomic burden and a public health concern as it is the leading cause of blindness worldwide and a significant cause of visual disability throughout the African continent. The current treatment for cataract surgery and SICS is the most popular surgical management option for cataracts in developing countries, mainly because of the low cost, short surgical time, reduced dependence on technology, and equivalent visual outcome phacoemulsification [9]. Through a sclera-corneal tunnel, SICS has also come as a boon, as it has been demonstrated that the smaller the incision, the lesser the number of sutures and valve-like construction of wound would induce minimal astigmatism [16].

Based on the previously mentioned facts, this prospective clinical study was conducted to study postoperative astigmatism after SICS with or without scleral tunnel suturing.

The mean age of patients in the current study was 61.93 ± 7.81 years in group A and 62.67 ± 6.64 years in group B. Different studies have shown that age is one of the most important factors responsible for cataract formation, and that 50% of patients more than 60 years of age have some amount of cataract, whereas those more than 80 years of age have 100% cataract [17]. Similarly, a recent study revealed that 75% of patients who underwent cataract extraction were above 50 years old with maximum preponderance in the age group between 61 and 70 years [18]. In a more recent study, most patients who underwent SICS belonged to the age group 60–69 years old [15].

Females represented 57.6% of patients included in the current study, and males represented 42.4%. A slightly higher risk of getting cataract was previously reported among females [19]. Moreover, there is evidence from epidemiologic data that cataract is more common in women than men. Estrogens are known to exert several anti-aging effects, and it has been hypothesized that the decrease in estrogen at menopause causes an increased risk of cataract in women, that is, not strictly the concentration of estrogen, but more the withdrawal effect [20].

Postoperative visual acuity is considered a vital index for evaluating the success of cataract surgery [8]. A review of follow-up results in the current study revealed gradual improvement in both groups' visual acuity. This finding comes

Table 2: Comparison of preoperative and postoperative clinical characteristics of patients in the two groups

	Group A (sutured)		Group B (sutureless)	
	Mean	SD	Mean	SD
Preoperative visual acuity	0.09	0.03	0.11	0.03
3 months postoperative visual acuity	0.55	0.11	0.57	0.11
Paired *t* test				
t	−24.76		−22.985	
P	0.001		0.001	
Preoperative refraction	−1.49	0.77	−1.60	0.87
Postoperative refraction	−1.57	0.66	−1.55	0.81
Paired *t* test				
t	0.931		0.678	
P	0.350		0.503	

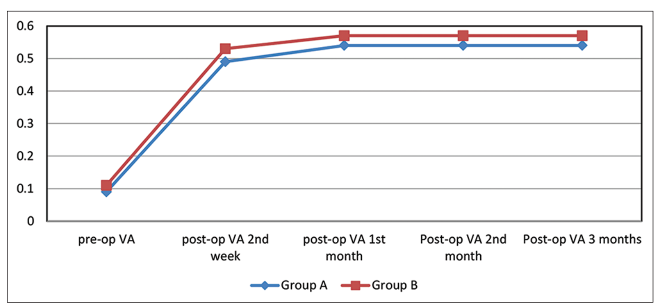

Figure 1: Preoperative and postoperative visual acuity in the two groups.

Table 3: Comparison of follow-up results in the two groups

	Group A (sutured)				Group B (sutureless)				Independent *t* test	
	Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum	*t*	*P*
Postoperative VA 2nd week	0.49	0.14	0.16	0.66	0.53	0.15	0.16	0.66	−1.100	0.276
Postoperative VA 1st month	0.54	0.11	0.33	0.66	0.57	0.11	0.33	0.66	−0.948	0.347
Postoperative VA 2nd month	0.54	0.11	0.33	0.66	0.57	0.11	0.33	0.66	−0.754	0.454
Postoperative VA 3 months	0.54	0.11	0.33	0.66	0.57	0.11	0.33	0.66	−0.754	0.454
Postoperative refraction	−1.59	0.66	−3	−0.5	−1.55	0.81	−3.75	−0.5	−0.234	0.816

VA, visual acuity.

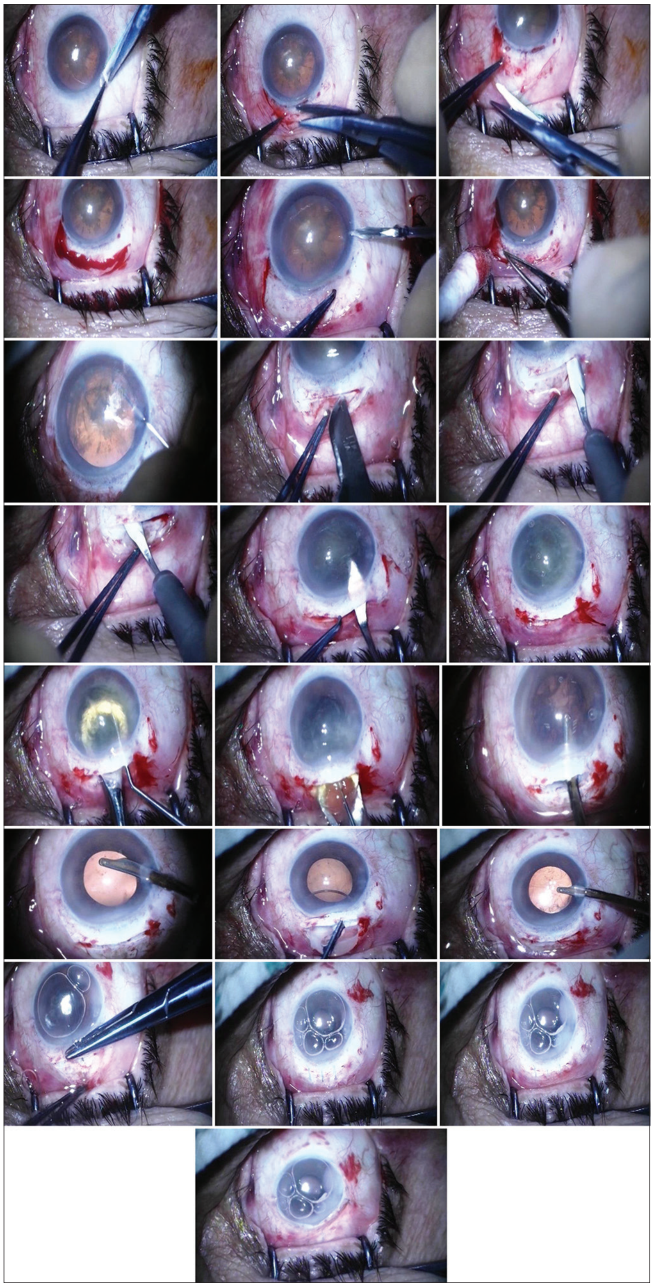

Figure 2: Surgical steps of group A cases.

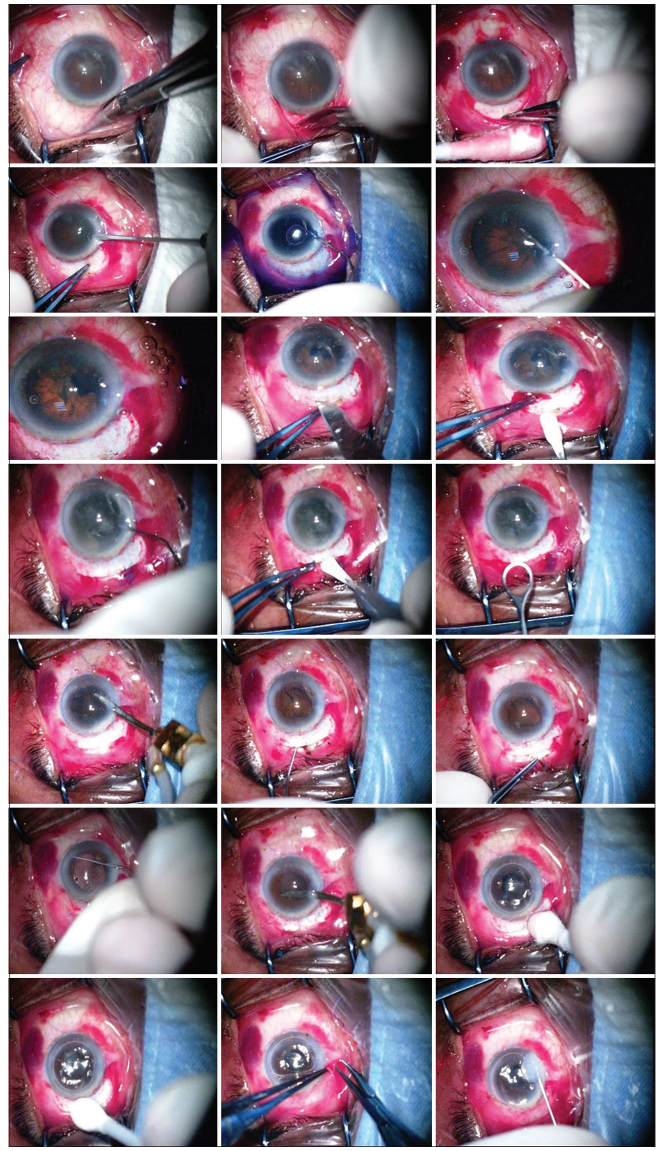

Figure 3: Surgical steps of group B cases.

in line with that reported in a previous study, in which SICS was performed in 301 eyes of 255 cases. This study revealed that the postoperative visual acuity was gradually improved over time and stabilized at 12 weeks postoperative [8].

A comparison of patients' preoperative and postoperative clinical characteristics in the present study revealed a highly statistically improvement in the visual acuity at 3 months postoperative in both groups. Meanwhile, postoperative refraction change compared with its preoperative value was not statistically significant in either group A or group B. When postoperative follow-up results in the two groups were compared, no statistically significant differences were found between both groups' visual acuity or refraction.

In Spain, a study was conducted on 110 eyes of 110 patients in whom the incidence of induced astigmatism following phacoemulsification with a 3.2 mm scleral tunnel incision with suture versus nonsuture technique was followed for 6 months. This research found that when a 3.2-mm self-sealing incision was used, the differences in SIA of sutured wounds and unsutured wounds following cataract surgery were not statistically important [21]. Similarly, after sutured and unsutured wound closure, astigmatism was insignificant following phacoemulsification with foldable IOL in 60 patients who were followed up for 4 weeks [17]. However, no previous studies have investigated postoperative astigmatism after SICS with or without scleral tunnel suturing to the best of our knowledge.

When interpreting these outcomes, several limitations related to the nature and actions of the study are important. These limitations include the allocation of patients into groups and masking of testers. Furthermore, the short follow-up period of 3 months cannot provide a complete evaluation of both methods' difference. That is why, more extensive studies with more extended follow-up periods are needed to confirm the results of the present study.

Conclusion

SICS performed either with or without scleral tunnel suturing was not associated with significant preoperative and postoperative astigmatism changes. Furthermore, no significant changes were found between sutured and sutureless groups regarding postoperative visual acuity or refraction. Therefore, it is a case situation and suitable for each case, according to the stability of AC and tight closure of scleral tunnel and conjunctival wounds.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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