Visual and astigmatic outcomes in manual small-incision cataract surgery versus phacoemulsification

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Received 15 August 2016
Accepted 10 December 2016

The Egyptian Journal of Cataract and Refractive Surgery 2016, 22:37–41

Background

The aim of this study was to compare the visual and astigmatic outcomes following manual small-incision cataract surgery (MSICS) versus phacoemulsification (PHACO) and to calculate the surgically-induced astigmatism (SIA) following both techniques.

Patients and methods

The study was conducted on 64 eyes of 63 consecutive patients with cataract who underwent either PHACO surgery (group 1; n=32) or MSICS (group 2; n=32). Patients were examined at day 1, 1 week, 1 and 3 months postoperatively. The basic postoperative parameters were uncorrected and best-corrected visual acuity. SIA was calculated using SIA calculator, version 2.1, in which the preoperative and postoperative K-readings and their axes were used.

Results

In the last postoperative visit after 3 months, the uncorrected visual acuity ranged between 6/18 and 6/9 in both groups. The visual acuity was markedly improved at 3 months of follow-up in comparison with preoperative status (P<0.0001) and in comparison with early postoperative status (P<0.0001). The PHACO group had a better visual acuity at 3 months of follow-up (P<0.01). After 3 months of follow-up, the mean SIA was 2.08 in the PHACO group, whereas it was 2.96 in the MSICS group. There was no statistically significant difference in either the amount (P=0.166) or the axis (P=0.195) of SIA between patients treated with PHACO and patients treated with MSICS.

Conclusion

MSICS is an effective, fast and economical technique and should be considered as an alternative to PHACO in certain cases.

Keywords:
manual small-incision cataract surgery, phacoemulsification, surgically-induced astigmatism

Egypt J Cataract Refract 22:37–41

1687-6997

Introduction

According to the WHO, cataract is the most common cause of blindness worldwide [1]. Cataract is the opacification of the normally transparent lens of the eye and occurs as a result of lens protein denaturation. This cloudiness can cause a decrease in vision and may lead to eventual blindness [2]. Surgery is the only effective method for the treatment of cataracts [3]. Manual small-incision cataract surgery (MSICS) and phacoemulsification (PHACO) are the surgical methods used most commonly [4]. PHACO is the most popular technique of choice for cataract surgery in the western world [5]. However, the higher cost of the PHACO machine and disposable supplies and the requirement for more advanced surgical training have limited the use of PHACO in most of the developing world [6]. In addition, the many advantages of PHACO have made it the gold standard for routine cataract surgery. There are, however, dense cataracts in which, even in expert hands, PHACO carries significantly higher risks; if the skill set is available, techniques such as MSICS may be the safer, more appropriate alternative. Several studies have shown both of these techniques to be equally effective [7,8]. The aim of this study was to compare the refractive outcome following MSICS versus PHACO and to calculate the surgically-induced astigmatism (SIA) following both techniques.

Patients and methods

The study was approved by the University Ethics Committee and followed the tenets of the Declaration of Helsinki. Participants were enroled in a prospective, consecutive comparative study. This study was performed at the Department of Ophthalmology, Sohag University, Egypt. We obtained written informed consent from all participants. The study was conducted on 64 eyes of

63 consecutive cataractous patients divided into two groups. Group A included 32 eyes that underwent phacoemulsification (the PHACO group), and group B included 32 eyes that underwent manual small-incision cataract surgery (the MSICS group) with at least 3 months of follow-up. Any cataract associated with other ocular pathologies was excluded from this study.

Preoperative ophthalmological examinations consisted of the uncorrected visual acuity (UCVA), refraction, best-corrected visual acuity (BCVA) using the Landolt metric chart, slit-lamp examination to detect the type of cataract, intraocular pressure measurements and fundus examination if possible.

Preoperative keratometry was performed using autokeratometer (TOPCON KR-8900; Topcon Corporation, Tokyo, Japan). A-scan (SONOMED PAC SCAN 300A; Escalon Medical Corp, New York, USA) was used to measure the axial length and to calculate the power of intraocular lens (IOL) aiming for emmetropia. B-Scan (Ophthalmic Ultra-Sonographic Scanner EZ SCAN AB5500) was used to check the posterior segment. Preoperative evaluation of the corneal endothelium was performed using a noncontact specular microscope (Topcon SP-1P; Topcon Corporation) in all cases.

All surgeries were performed by a single surgeon. Retrobulbar anaesthesia was performed for all cases using mepivacaine HCl 2%.

Manual small-incision cataract surgery technique

Superior rectus bridle suture was used. A conjunctival peritomy was performed followed by a limited wet-field cautery. A superior corneal–scleral tunnel was created by holding blade no. 15 perpendicular to the sclera, and a partial-thickness (50%) scleral incision 6–7 mm in length was made according to the expected size of the nucleus. The tunnel was Frown shaped and 2 mm from the limbus. A self-sealing tunnel incision was made using a crescent blade. This incision was widened to ~9.0 mm as it advanced into the clear cornea, being careful not to enter the anterior chamber until after the capsulotomy is performed. A large capsulorrhexis (6–7 mm) was performed by bending a 27 G needle in two places at the tip of the needle away from the bevel and at the base of the needle towards the bevel and gently curving the area between the two bends away from the syringe. The needle is inserted through the side port to allow continuous curvilinear capsulorrhexis in a closed chamber after filling the anterior chamber with methylcellulose. A 3.0-mm keratome blade was used to open the internal lip of the tunnel incision.

Hydrodissection was performed followed by prolapse of the nucleus into the anterior chamber using the cannula of the methylcellulose syringe and then extracted in one piece using the viscoelastic or the vectis introduced under the nucleus. Cortical clean-up was performed with the Simcoe irrigating–aspirating cannula with adequate flow rate attached to 10 ml syringe. Following removal of the cortex, the anterior chamber was reformed with methylcellulose 2%, and then a 6.5 mm polymethylmethacrylate IOL was inserted in the capsular bag. The side port was hydrated, and the anterior chamber was pressurized and monitored for wound leakage by applying gentle external pressure.

Corneal wound is self-sealing and does not require suturing.

Ballooning of the conjunctiva was performed by injecting gentamycin into the subconjunctival space to close the conjunctiva over the scleral wound.

Phacoemulsification technique

PHACO surgery was performed through a 2.4-mm sutureless superior clear corneal incision. The Alcon infinity PHACO machine (Alcon, Fort Worth, Texas, USA) was used in all cases. The stop-and-chop technique was the preferred technique for nucleus emulsification. A one-piece hydrophobic acrylic foldable IOL (Alcon AcrySof SN60; Alcon) was implanted into the capsular bag in all eyes.

Patients were examined at day 1, 1 week, 1 and 3 months postoperatively. The basic postoperative parameters in each follow-up visit included slit-lamp examination to evaluate corneal condition and to detect any postoperative inflammation, as well as assessments of UCVA and BCVA. SIA was calculated using SIA calculator, version 2.1, in which the preoperative and postoperative K-readings and their axes were used. Any complications, either intraoperatively or postoperatively, with either technique were recorded.

Statistical analysis

Data were analysed using STATA intercooled, version 12.1. Quantitative data were represented as mean and SD. Data were analysed using Student's *t*-test to compare means of two groups. Qualitative data were presented as numbers and percentages and compared using the χ^2-test. Multivariate regression analyses were performed to determine different eye parameters. *P* value was considered significant if it was less than 0.05.

Results

The study included 64 eyes of 63 consecutive patients with visually significant cataract. They were divided into two groups: group 1 (*n*=32), which underwent PHACO, and group 2 (*n*=32), which underwent MSICS. The characteristics of the studied population are shown in Table 1. Types of cataract are presented in Table 2.

Preoperative assessment of the patients showed that 12 patients had visual acuity of hand movement, whereas visual acuity of the remaining cases ranged from 6/190 to 6/38 with a mean of 6/75 (Table 3).

Table 3 shows no significant difference in preoperative visual acuity between patients treated with PHACO and those who underwent MSICS modalities (*P*=0.82).

As regards postoperative UCVA in the first week, one patient had persisting preoperative visual acuity of 6/150 in the MSICS group due to severe postoperative keratitis, but visual acuity of the remaining cases ranged from 6/60 to 6/12 in the PHACO group and from 6/38 to 6/18 in the MSICS group. There was a statistically significant improvement in patients compared with preoperative status (*P*<0001). The PHACO group had a better UCVA in the first postoperative week and the difference was statistically significant (*P*=0.001).

In the last postoperative visit after 3 months, the UCVA ranged between 6/18 and 6/9 in both groups (Table 4). The visual acuity was markedly improved at 3-month follow-up in comparison with preoperative status (*P*<0.0001) and in comparison with early postoperative status (*P*<0.0001). The PHACO group had a better UCVA and BCVA at 3-month follow-up (*P*<0.01).

The induced astigmatism was assessed by measuring the K-readings and their axes in every visit during the postoperative period and comparing the results with the preoperative K-readings.

After 3 months of follow-up, the mean SIA was 2.08 in the PHACO group, whereas in the MSICS group it was 2.96. However, SIA axis ranged between 2 and 177 in both groups. There was no statistically significant difference in the amount (*P*=0.166) or axis (*P*=0.195) of SIA between patients treated with PHACO and patients treated with MSICS.

As regards the intraoperative complications, vitreous loss occurred in two (3.1%) patients of the MSICS

Table 1 Sociodemographic characteristics of the patients

Characteristics	PHACO [*n* (%)]	MSICS [*n* (%)]	Total	*P* value
Age (years)				
Minimum	48	50	48	0.53
Maximum	75	75	75	
Mean±SD	56.22±9.47	63.81±8.76	60.02±9.8	
Sex				
Male	20 (31.3)	19 (29.6)	39 (60.9)	0.80
Female	12 (18.8)	13 (20.3)	25 (39.1)	
Affected side				
Right eye	10 (15.6)	15 (23.5)	25 (39.1)	0.2
Left eye	22 (34.4)	17 (25.7)	39 (60.1)	

MSICS, manual small-incision cataract surgery; PHACO, phacoemulsification.

Table 2 Preoperative cataract morphology in both groups

Cataract morphology	PHACO	MSICS
Nuclear		
Grade 2	7	8
Grade 3	10	9
Cortical	6	4
Posterior subcapsular	5	5
Mature (white)	4	6
Total	32	32

MSICS, manual small-incision cataract surgery; PHACO, phacoemulsification.

Table 3 Preoperative visual acuity of the investigated cases

Visual acuity	PHACO	MSICS	*P* value
Hand movement	5	7	0.82
6/190	2	5	
6/150	6	6	
6/120	2	1	
6/95	4	3	
6/75	4	4	
6/60	1	1	
6/48	4	4	
6/38	4	1	
Total	32	32	

MSICS, manual small-incision cataract surgery; PHACO, phacoemulsification.

Table 4 Postoperative uncorrected visual acuity after 3 months

Visual acuity	PHACO	MSICS
6/18	3	7
6/15	5	6
6/12	6	6
6/10	8	8
6/9	10	5
Total	32	32

MSICS, manual small-incision cataract surgery; PHACO, phacoemulsification.

group. The postoperative complications were keratitis in nine (14%) patients of the MSICS group and resolved within 1 week postoperatively. Decentred IOL was recorded in two (3.1%) patients of the MSICS group and required dialling.

Discussion

The MSICS is one of the effective techniques for cataract surgery [9]. Multiple studies compared the safety, efficacy and cost of this technique with the PHACO [5,7,8,10].

This study was a comparative prospective case-series study that aimed to compare the visual outcome and SIA between PHACO and MSICS in the management of age-related cataracts.

In this study, the PHACO group had a better UCVA in the first postoperative week and the difference was statistically significant (P=0.001). The UCVA in the first week ranged between 0.1 and 0.5 in the PHACO group and between 0.172 and 0.33 in the MSICS group. Moreover, after 3 months of follow-up, the PHACO group had a better UCVA (P<0.01) but nearly equal BCVA ranging between 0.6 and 0.9.

Three randomized prospective studies conducted in developing countries have compared PHACO with MSICS. In these, MSICS was comparable to PHACO in achieving excellent visual outcomes [11]. Venkatesh *et al.* [12] obtained the results similar to ours; they reported that UCVA of 6/18 or better was achieved in 87.6% of eyes in the PHACO group and 82% of eyes in the MSICS group by 6 weeks postoperatively. The corresponding BCVA of 6/18 or better was achieved in 99% from the PHACO group and 98.2% from the MSICS group by 6 weeks postoperatively.

Gogate *et al.* [8] compared PHACO with MSICS and reported that UCVA of 6/18 or better was achieved in 81.08% of eyes in the PHACO group, versus 71.1% of eyes in the MSICS group at 6 weeks postoperatively. The BCVA was 6/18 or better in 98.4% of eyes in both groups at 6 weeks postoperatively.

Unlike the above two studies in which the follow-up period was short, Ruit *et al.* [7] in their study followed up patients for 6 months. They reported comparable rates of 98% achieving BCVA of 6/18 or better at 6 months postoperatively. UCVA was comparable at 6 months.

Moreover, the same result was obtained by Riaz *et al.* [12] in their review study conducted on 1708 participants and concluded that removing cataract by means of PHACO may result in better UCVA in the short term (up to 3 months after surgery) compared with MSICS, but similar BCVA.

A previously published report showed no significant difference between MSICS and PHACO in improving 1-week-postoperative UCVA [13].

This study revealed that SIA amount was 2.08 in the PHACO group and 2.96 in the MSICS group. The SIA axis ranged between 2 and 177 in both groups. There was no statistically significant difference in either the amount (P=0.166) or the axis (P=0.195) of SIA between patients treated with PHACO and patients treated with MSICS.

The same results were obtained by Ruit *et al.* [7] at 6-month follow-up. They reported a mean astigmatism of 0.7 D for the PHACO group and 0.88 D for the MSICS group. This difference was not statistically significant. Moreover, Gogate *et al.* [8] at 6 weeks postoperatively reported a mean astigmatism of 1.1 D for PHACO and 1.2 D for MSICS, which was not statistically significant.

Another study [14] conducted to compare SIA associated with PHACO and MSICS reported no significant difference at either the 6-week or 6-month follow-up examination.

Different results were obtained by both Venkatesh *et al.* [12] and George *et al.* [15]; they reported that PHACO caused significantly lesser SIA compared with MSICS at 6 weeks postoperatively.

Other MSICS studies report differences in SIA based on the incision size made and the type of tunnel [11].

These studies revealed changes in SIA in MSICS according to size, location and the construction of the wound [16–19].

As regards the intraoperative complications, vitreous loss occurred in two (3.1%) patients of the MSICS group. The postoperative complications were keratitis in nine (14%) patients of the MSICS group and resolved within 1 week postoperatively. Decentred IOL was recorded in two (3.1%) patients of the MSICS group and required dialling.

Ye *et al.* [20] mentioned in a meta-analysis study that there was no significant difference between MSICS and PHACO in posterior capsule rupture.

Moreover, the same authors [20] mentioned that, there was no significant difference between MSICS and PHACO in corneal oedema on postoperative day 1.

Conclusion

MSICS is an effective, fast and economical technique. MSICS has no steep learning curve. MSICS must be considered as an alternative to PHACO in very hard cataract cases, in which the cornea may be compromised by the excessive use of ultrasound power and in developing countries, where the possession of sophisticated and expensive instruments such as a PHACO machine is not viable for most institutions.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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