Comparison of Surgically Induced Corneal Astigmatism in Cataract Patients after Phacoemulsification Versus Manual Small-Incision Cataract Surgery

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Abstract

The advances in cataract surgery are aimed at finding a surgical method capable of providing accurate and predictable results in terms of outcome. Surgically Induced Astigmatism (SIA) is one of the causes of the poor quality of vision post-operatively because of the blurring of images. SIA in turn, depends on the type, length and the position of the incision.so this study to compare the mean keratometeric reading preoperative and one month postoperative in phacoemulsification versus manual small-incision cataract surgery and to find which produce less surgically induced astigmatism. This was a prospective, observational, cohort study on patient with cataract carried out from April 2018 to September 2018. This study conducted on (206) patients attending to ophthalmic department in Najaf. The cases were divided into two groups. Each group had 103 patients. One group had undergone phacoemulsification and the other group had undergone superior scleral tunnel incision and follow up after one month to find which procedure less surgically induced astigmatism. Preoperative and postoperative keratometeric was performed after one month. According to this study mean keratometeric reading in the Phaco group preoperative k1= 43. 80, k 2= 44.69 and postoperative k1 = 43.71and K2 =44.62.While Mean keratometeric reading in the SSTI group preoperative k1=44.00, K2 = 45.02 and postoperative k1 =43.91 and K2= 45.41.

Mean astigmatism at one month postoperative in patient undergoing Phaco was 1.3 ±0.9 and undergoing SSTI was 1.3± 0.7, there was no statistical difference in astigmatism at one month postoperative (P=0.5).

This study reveals that superior approach in PHACO and MSICS produced similar astigmatic outcome, there is no significant difference in the mean surgically induced astigmatism in both types of surgery.

Keyword: *cataract surgery, Phacoemulsification, manual small-incision cataract surgery, Surgically Induced Astigmatism, incision site*

Introduction

The sclera forms the posterior five-sixths of the connective tissue coat of the globe. The sclera maintains the shape of the globe, offering resistance to internal and external forces, and provides an attachment for the extraocular muscle insertions. [1] The transition zone between the peripheral cornea and the anterior sclera, known as the limbus. The surgical limbus can be divided conceptually into two equal zones: anterior bluish-gray zone and posterior white zone. [2] The cornea is a transparent structure at the front of the eye. It is a powerful refractive surface and a robust barrier that protects the ocular contents. Peripheral corneal asphericity reduces optical blur from spherical aberration [3] The crystalline lens is biconvex, avascular, transparent structure enclosed by capsule, which is basement membrane secreted by lens epithelium. The normal lens transparent any congenital or acquired opacity in the lens capsule or substance, irrespective of the effect on vision, is a cataract. [4]

Cataract poses both a significant socioeconomic burden and a public health concern, as it is the leading cause of blindness worldwide. [5]. By far the most

important risk factor for cataract is age; ageing-related cataract constitutes the great majority of all cataracts and is a major public health problem worldwide. In developing countries, where the availability of surgical facilities is limited, ageing-related cataract is the leading cause of blindness. Because at present there is no efficacious non-surgical therapy for cataract, the problem is expected to increase in magnitude in coming decades as the world population becomes progressively older. [6] The change of surgical techniques from large corneal incision to phaco has great effect on SIA. [7] The current treatment for cataract is surgery while phaco remains the more advanced and technically superior method of cataract surgery; manual small incision cataract surgery (MSICS) is the most popular surgical management option for cataracts in developing countries. [8] The first, phaco, involves using a high frequency ultrasound probe to fragment the lens, and this machine also removes the lens fragments from the eye. The second, called MSICS involves using instruments to remove the lens from the eye through a small incision. [9] Advantage of phaco versus MSICS was smaller wound size, faster healing time, fewer wound problems (wound leak and iris prolapse) less astigmatism, less risk of expulsive hemorrhage; operation can perform under topical anesthesia and conjunctival sparing. Disadvantage of phaco versus MSICS was machine dependent, longer learning curve and higher complication rate during learning curve. [10] At present time, cataract surgeries by phaco through clear corneal incision have become principal method for cataract surgery because of its bloodless and fast approach. The postoperative SIA has always been concern to most surgeons. [11] Post cataract surgery astigmatism causes a delayed in visual rehabilitation, limiting the visual outcome and reduces the effectiveness of the surgical procedure. [12] Factor like location, direction, length, width, depth, and shape of incision, types of suture and suture material have been found to influence the astigmatism.[13] Low induced astigmatism, faster healing of corneal wound and no direct damage to cornea justify the usage of small self-sealing sclera-cornea tunnel incision.[14] With reference to the location of the incision, placing the incision on the steeper corneal meridian based on the preoperative keratometeric reading has been recommended [15] .The idea is that because of the one-to-one coupling from corneal incisions, there is flattening of the corneal curvature in the meridian on which the incision is placed, with a corresponding steepening to the same degree of the orthogonal meridian [16]. Thus, there will be a reduction in the corneal power of the steeper meridian when an incision is placed on that meridian, with a corresponding steepening to the same degree of the flat orthogonal meridian. The difference in corneal powers between the flattened steeper meridian (meridian on which the incision was placed) and the steepened flatter meridian will then be reduced postoperatively leading to minimal postoperative corneal astigmatism. [17]

Aim of Study

1- To compare the mean keratometeric reading preoperative and one month postoperative in phacoemulsification versus manual small-incision cataract surgery

2- To find which produce less surgically induced astigmatism.

Patients and Methods

This was a prospective, observational, cohort study in patients with cataract carried out from April 2018 to September 2018. This study conducted on (206) patients attending to Al-Sadder medical city in Najaf.

The cases were divided into two groups. Each group had 103 patients. One group had undergone phacoemulsification and the other group had undergone MSICS with one month for follow up.

Inclusion Criteria

Patient having cataract of any grade affect the vision

Exclusion Criteria

1. Patients with additional visual comorbidity, which may influence the visual outcome after surgery, glaucoma, and corneal pathology.

2. Patient having temporal incision.

3. Patients with traumatic, subluxated cataract.

Preoperative ophthalmological examinations consisted of the best-corrected visual acuity using the Snellen metric chart, slit-lamp examination to detect the type of cataract, intraocular pressure measurements and

fundus examination if possible.

Preoperative keratometeric reading was performed using autokeratometer A-scan was used to measure the axial length and to calculate the power of intraocular lens (IOL) aiming for emmetropia. B-Scan (Ophthalmic Ultrasonography Scanner was used to check the posterior segment and postoperative keratometry and auto refraction was performed using autorefractokeratometer after one month.

Surgical procedure:

After pupil dilation, under aseptic approach ,local anesthesia was given, In the manual small-incision cataract surgery steps[9] And in phaco group steps [9]

Data collection:

Name, Age, sex, side of eye, k-reading (k1, K2) preoperative, after one-month postoperative k- reading and autorefraction.

Patient name **Age** **Sex**		
Eye	**Right**	**left**
k-reading	K1	K2
Preoperative		
Postoperative (After one month)		
Auto-refraction		

Data of the studied group were entered and analyzed using the statistical package for social sciences, SPSS, version 20. Analytic statistics presented as mean, standard deviation (for the age, keratometeric reading and astigmatism), and proportions (for categorical variables). Chi square test was used to compare patients with regard to age group and gender. Data were analyzed using Student's t-test for means difference of two groups. Qualitative data were presented as numbers and percentages and compared using the $\chi 2$-test Level of significance, P. value of less than or equal 0.05 was considered as significant. Results presented in tables.

Findings

Table 1 Gender, side and age distribution of the studied group (N =206)

Characteristics		**Type of operation**		**Total**	**P**
		Phaco n =103 No. (%)	**MSICS n=103 No. (%)**		
Gender	Female	61 (59.2)	55 (53.4)	116 (56.3)	0.4
	Male	42 (40.8)	48 (46.6)	90 (43.7)	
Side	Rt	51 (49.5)	44 (42.7)	95 (46.1)	0.3
	Lt	52 (50.5)	59 (57.3)	111 (53.9)	
Age (Mean ± SD)		58.69±10.4	62.56±7.9		0.003

Table 2 Preoperative and postoperative mean keratometeric reading

Reading	Phaco N=103 Mean± SD	MSICS N=103 Mean± SD	p
Pre k1	43.80 ± 1.905	44.00 ± 1.757	0.4
Pre k2	44.69±1.764	45.0 ±1.725	0.2
Post k1	43.71±1.757	43.91±1.766	0.4
Post k2	44.62±1.714	45.14±1.856	0.04

Table 3 Distribution of SIA after one month in the patients according type and study group

Type of astigmatism	Type of operation		Total	P
	Phaco n=103No. (%)	MSICS n=103No. (%)		
With rule astigmatism"	21 (20.4)	20 (19.4)	41 (19.9)	0.9
"Against rule astigmatism"	64 (62.1)	65 (63.1)	129 (62.6)	
"Oblique astigmatism"	16 (15.5)	16 (15.5)	32 (15.5)	
"No astigmatism"	2 (1.9)	2 (1.9)	4 (1.9)	
Total	103 (100)	103 (100)	206 (100)	

Table 4 Postoperative autorefractive reading of astigmatism and mean SIA in the patient according type and study group

Postoperative autorefraction cylindrical	Type of operation		Total	P
	Phaco n=103 No. (%)	MSICS n=103 No. (%)		
0-0.50 D	31(30.3)	17 (16.5)	48(23.4)	0.07
0.51-1.00 D	27 (26.2)	38 (36.9)	65 (31.5)	
1.01-1.50 D	22 (21.3)	18 (17.5)	40 (19.4)	
1.51-2.00 D	9 (8.7)	17 (16.5)	26 (12.6)	
more tnan2.01 D	14 (13.5)	13 (12.6)	27 (13.1)	
Total	103 (100)	103 (100)	206 (100)	
Mean SIA± SD	1.3±0.9	1.3±0.7		0.5

Discussion

This study was comparative prospective cohort study that compares SAI between phaco and MSIC surgery. In the phaco group difference keratometeric reading between preoperative and postoperative K1 = 0.09 and K2 = 0.07. In the MSICS group difference keratometeric reading between preoperative and postoperative K1= 0.09 and K2 = -0.14. There was no significant difference between preoperative and postoperative mean k1 reading in both phaco and MSICS group and slight change in mean K2 reading. The distribution of postoperative astigmatism in Phaco was higher incidence of against rule astigmatism 62.1%, with rule astigmatism 20.4%, oblique astigmatism 15.5% and no astigmatism 1.9% among of that 103 patients with shifted toward against rule astigmatism. The distribution of postoperative astigmatism in the group MSICS was higher incidence of against rule astigmatism 63.1%, with rule astigmatism 19.4%, oblique astigmatism 15.5% and no astigmatism 1.9% among of that 103 patients with shifted toward against rule astigmatism. Generally, the corneal astigmatism seen is with-the-rule in young patients and there is a shift towards against-the rule astigmatism as age advances. With the rule, astigmatism in younger age can be due to the upper and lower lids compressing a portion of the cornea and causing steepening of the vertical curvature. However, as age advances - the compressive effect of the lids is lessened by lid laxity, decreased tone of Muller's muscle and increased corneal rigidity. [18] Our study correlates with the observation made by Reddy B et al[19] concluded that significantly against the rule shift in astigmatism in the phacoemulsification group and the MSICS superior incision group. Like our study with observation made by Renu M Magdum et al[20] where Post operatively at the end of 3rd month in superior MSICS group, majority of the patients (74%) had ATR astigmatism and only 8 (16%) of the patients had WTR astigmatism. This is because incision on the vertical meridian causes flattening of the vertical meridian and steepening of the horizontal meridian leading to ATR shift. In temporal incision group, majority of the patients (56%) had WTR astigmatism as the incision on the horizontal meridian n causes flattening in that meridian and steepening along the vertical meridian leading to WTR shift. Unlike our study with observation made by Latha N. et al [21] comparing the Superior corneo-scleral incision and clear corneal incision, ATR was found to be 60% in Superior corneo-scleral and 32% in Superior clear corneal incision. Superior clear corneal incision tends to produce less ATR astigmatism than corneo-scleral incision while in our study was no significant differences, both surgeries produced ATR astigmatism. Mean astigmatism at one month postoperatively in patients undergoing phaco was 1.3D. Mean astigmatism at one month postoperatively in patients undergoing MSICS was 1.3 degree. There was no statistical difference in astigmatism at one month postoperative (p =0.5) .Our study correlates with the observation made by Kalaf M. et al .[22] the mean SIA was 2.08 in the PHACO group, whereas in the MSICS group it was 2.96. There was no statistically significant difference in the amount (P=0.166) of SIA between patients treated with phaco and patients treated with MSICS. The same results were obtained by Ruit et al. [23] The result obtained by Kağnici1 D et al [24] ;mean SIA was less in the group with limbal incision than in the group with corneal incision on postoperative first day, first week and first month. However, this difference was not statistically significant. Different results were obtained by both Venkatesh et al. [25] and George et al. [26]; they reported that phaco caused significantly lesser SIA compared with MSICS at 6 weeks postoperatively.

Conclusions

This study reveals that superior approach in PHACO and MSICS produced similar astigmatic outcome, there is no difference in the mean surgically induced astigmatism in both type of surgery.

Recommendations:

In both type of surgeries had similar results, MSICS can be consider as alternative to PHACO in very hard cataract cases , in which the cornea may be comprised by excessive uses of ultrasound power and affect the outcome .

Conflict of Interested: Nil

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Ethical committee :

1. The council of Faculty of Medicine / Kufa University and the Department of ophthalmology approved the study protocol.

2. Official agreements were obtained.

3. Patient's agreements were obtained.

Data and information of the participants were kept confidentially and not disclosed to unauthorized personal

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