

Comparison of Surgically Induced Astigmatism between Single Plane and Three Plane Incision Following Temporal Approach Phacoemulsification in Pre-Existing against-the-Rule Astigmatism Patients

Rini Kusumawar Dhany*

Ophthalmology Department, Dr Wahidin Soedirohusodo General Hospital/Faculty of Medicine, Wijaya Kusuma University, Surabaya, Indonesia

*Corresponding Author: Rini Kusumawar Dhany, Ophthalmology Department, Dr Wahidin Soedirohusodo General Hospital/Faculty of Medicine, Wijaya Kusuma University, Surabaya, Indonesia.

Received: February 11, 2019; Published: April 30, 2019

Abstract

Background: To compare surgically induced astigmatism of two group configuration single plane and three plane phacoemulsification incision in pre-existing against-the-rule astigmatism patients.

Methods: All 40 patients underwent phacoemulsification by one surgeon and performed the two groups of patient main single plane (group A) and three plane clear corneal 2.8 mm incision (group B). Both groups used a disposable keratome knife and the NIDEK CV 9000 phacoemulsification machine. Preoperative exclusion criteria were previous anterior segment surgery, dry eye syndrome, chronic use of eye drops and corneal pathology, astigmatism > 3 dioptres in both meridians, small pupil less than 5.5 mm after dilation, hard and brown cataract grading according to Lens Opacity Classification System (LOCS) III system of NC5N05, NC6N06 as factors stressing the main incision, pseudo exfoliation syndrome, primary or secondary glaucoma were excluded. Exclusion criteria were suturing of the incisions postoperative, enlargement of main incision because of difficult surgery, and floppy iris.

Result: The mean age of the patients of group A was 58.05 ± 8.66 SD years and in group B was 60.05 ± 9.89 SD years. The mean post-operative SIA in group A was 0.86 ± 41.74 on first day, 0.28 ± 11.64 D on the 7th day, which reduced to 0.27 ± 8.02 D after 30 days. In group B the SIA on first day was 1.00 ± 50.65 , 0.72 ± 28.18 D after 7 days was, whereas it reduced to 0.58 ± 29.60 D after 30 days. The means difference of two groups seventh day and first month post phacoemulsification was statistically significant with p-value of 0.000 ($p > 0.05$) as obtained using independent t-test.

Conclusion: Temporal single plane incision significantly reduce corneal astigmatism compare with three planes incision in pre-existing ATR astigmatism.

Keywords: Surgically Induced Astigmatism; Configuration Incision; Temporal Approach Phacoemulsification

Introduction

In phacoemulsification surgery, parameters of surgically induced astigmatism are incision size, central corneal thickness, configuration (1-, 2-, 3-plane), location to the limbus and axis on which the main incision is performed. With increasing age, the magnitude of astigmatism increases and ATR astigmatism becomes increasingly prevalent. Our usual temporal phacoemulsification incision will affect these types of eyes differently [1-3]. With-the-rule astigmatism vertical meridian steeper than horizontal meridian, with the greatest refractive power between 120 to 60 degrees. This type is more commonly found in younger patients and myopic eyes. The cornea tends to slowly change over time and with age, and patients typically develop a shift from either no astigmatism or WTR astigmatism to a degree of ATR

astigmatism. The most commonly seen astigmatism cataract patients is ATR [4]. Against-the-rule astigmatism has a steep corneal axis at the 180° meridian. The greatest refractive power present between 0 to 30 and 150 to 180. This position means that our typical cataract surgery incisions, which are placed temporally, tend to be near this steep axis. Temporal corneal incision for phacoemulsification is the most common entry site for cataract surgery. There are some benefits of temporal incision compare to superior incision. It provides better access to the anterior chamber for difficult patients with prominent brows or narrow palpebral fissures, and it is farthest from the visual axis and therefore less induce astigmatism. Corneal phacoemulsification incisions induce flattening and a decrease in the astigmatism where they are placed. Cornea has coupling effect, that means if one meridian of the cornea is flattened, then the corresponding meridian 90° away will be steepened by approximately the same amount. This means that the average corneal power, as used in IOL power calculations, is minimally affected by the main phacoemulsification incisions, accessory incisions or even limbal relaxing incisions [1,5].

Methods

This prospective study was performed in Mojokerto General Hospital from September 2017 to March 2018. Steepest meridian on $180 \pm 30^\circ$ was considered as ATR astigmatism. All patients underwent phacoemulsification by one surgeon and performed the two groups of patient main single plane and three plane clear corneal incision, 2.8 mm incision width, 180 - 210° for the right eye and 0 - 30° for the left eye [6] (Figure 1). Both groups did not perform stromal hydration, used a disposable keratome knife and the NIDEK CV 9000 phacoemulsification machine. One plane incision defined as straight direct the tip of the blade parallel to the iris plane and enter the anterior chamber. Three plane incision defined as the side of the blade parallel to the iris plane about 1 mm into stroma, then change the position of side of blade to the tip, upward 45° from corneal surface then straight enter the anterior chamber. This study was approved by the Hospital's Ethics Committee. All the patients provided written informed consent to participate in the study. Those above the age of 40 years who understood the study and were willing were enrolled. Patients with posterior subcapsular cataract, cortical cataract, or posterior polar cataract were included, and grading was done according to Lens Opacification Classification System II. Preoperative exclusion criteria were previous anterior segment surgery, dry eye syndrome based on Shirmer test, chronic use of eye drops and corneal pathology. Patients with astigmatism of more than three dioptres (D) in both meridians, small pupil less than 5.5 mm after dilation, hard and brown cataract grading according to Lens Opacity Classification System (LOCS) III system of NC5NO5, NC6NO6 as factors stressing the main incision, pseudo exfoliation, primary or secondary glaucoma were excluded. Also, those not willing to participate in the study and lost to follow-up were excluded subsequently. Post-operative exclusion criteria were suturing of the incisions, complicated surgery necessitating enlargement of the tunnel incision and iris prolapse. Preoperatively all patients underwent a full ophthalmologic examination. Biometry was performed with A-scan U/S. Three serial keratometry measurements were performed with automated refractometer RK 6000 Reichert., AMETEK, USA. Location of tunnel and side port incision were marked on the operating microscope before operation. Postoperative follow up was scheduled on 1st day, 7th day and 1st month after surgery. Best corrected visual acuity using Snellen optotype and auto-keratometry were performed. SIA was calculated by SIA calculator. A stab side port clear corneal incision 1.0 mm was made coaxially 90° of main incision. All eyes were under medication therapy with a combination of neomycin-polymyxin-dexamethasone eye drops every 3 hours times a day for 3 weeks tapering off. The mean difference of SIA between 7th and 30th day was statistically evaluated using independent t-test, and all the analyses were performed using SPSS 18.0 (SPSS Inc.) software.

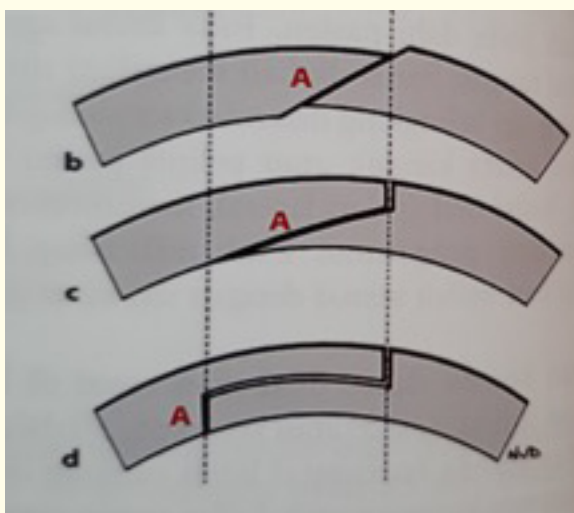


Figure 1. Configuration Incision types. b. Single plane. c. Two planes. d. Three planes

Results

The mean age of the patients of group A was 58.05 ± 8.66 SD years and in group B was 60.05 ± 9.89 SD years. In group A, there were 17 (42.5%) men and 23 (57.5%) women, whereas in group B the men numbered 68 (55.3%) and women 55 (44.7%). Table 1 mentioned the corneal astigmatism distribution pre and post-operative from the first day, seventh day and the first month in both groups. The post-operative keratometry result and SIA calculation of both group are mentioned in table 2. The mean postoperative SIA in group A was 0,86 ± 41.74 on the first day, 0.28 ± 11,64 D on the 7th day, which reduced to 0.27 ± 8,02D after 30 days. In group B the SIA on the first day was 1.00 ± 50.65, 0.72 ± 28,18 D after 7 days was, whereas it reduced to 0.58 ± 29,60 D after 30 days. The difference in the two means of 7th day and 1st month post operation was statistically significant with p-value of 0.000 (p > 0.05) as obtained using independent t-test.

Keratometric astigmatism in diopters (D)	Preoperative		Day 1 Postoperative		Day 7 Postoperative		Day 30 Postoperative	
	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
0 - 0,50	7 (35%)	4 (20%)	5 (25%)	6 (30%)	20 (100%)	3 (15%)	20 (100%)	12 (60%)
0.51 - 1.00	9 (45%)	10 (50%)	10 (50%)	5 (25%)		12 (60%)		4 (20%)
> 1.00	4 (20%)	6 (30%)	5 (25%)	9 (45%)		5 (25%)		4 (20%)
Total	20	20	20	20	20	20	20	20

Table 1: Corneal astigmatism distribution pre and post-operative in both groups.

No	Date	Single plane group Name	Age	Medical record	Keratometry pre op	Keratometry post op 1 st day	SIA 7 th day	SIA 30 th day
1	7/9/2018	Mr. A	59	W1707118011	42.00X88 43.00X178	42.50X94 43.25X4	0.31	0.21
2	23/9/2018	Mrs. M	78	W1701108600	44.25X119 45.00X 29	44.25X139 45.00X49	0.21	0.21
3	14/10/2018	Mr. S M	55	S1507071376	43.25X107 44.00X17	42.75X102 43.75X12	0.29	0.21
4	14/10/2018	Mrs..S	69	W1510076596	44.25X117 45.00X27	7.30X111 7.27X21	0.24	0.24
5	15/11/2018	Mrs. ST	55	S1301004702	44.25x83 45.50x173	44.00x82 45.50x172	0.25	0.21
6	15/11/2018	Mrs. SW	64	W1803277246	45.50X10 45.75X100	44.75X127 45.00X37	0.45	0.24
7	14/12/2018	Mr. M	42	W1803277727	44.25X107 45.00X17	44.25X99 45.00X9	0.21	0.25
8	114/12/2018	Mrs. S	53	W1710123173	47.00X20 45.75X110	46.50X30 45.50X210	0.46	0.31
9	15/2/2018	Mrs. M	55	S14090521080	44.00x22 45.50x112	44.00x18 45.25x108	0.31	0.42
10	21/3/2018	Mrs.Mu	48	W1804278515	43.50X109 44.50X19	43.25X100 44.50X10	0.43	0.21
11	21/3/2018	Mrs.MI	58	W1512080714	43.00X47 44.00X137	43.50X35 44.50X125	0.42	0.25

Comparison of Surgically Induced Astigmatism between Single Plane and Three Plane Incision Following Temporal Approach Phacoemulsification in Pre-Existing against-the-Rule Astigmatism Patients

12	21/3/2018	Mrs. M	68	S13010032090	44.00x22 45.50x112	44.00x18 45.25x108	0.31	0.24
13	12/2/2018	Mrs. SR	63	W180274599	7.53X40 7.27X220	7.30X111 7.27X21	0.24	0.21
14	21/1/2018	Mr.A	57		44.00x22 45.50x112	44.00x18 45.25x108	0.31	0.31
15	7/1/2018	Mr. P	55	S1403037673	43.25X86 43.75X176	43.50X102 44.25X12	0.42	0.51
16	19/2/2018	Mrs. M	64	S1402037476	44.25X117 45.00X27	44.25X199 45.00X59	0.21	0.21
17	20/05/2018	Mr. M	42	W1803277727	44.00X105 44.75X15	44.00X22 45.00X112	0.41	0.31
18	7/3/2018	Mr.P	59	W1709122161	44.00X116 44.75X26	44.25X111 44.75X21	0.43	0.24
19	15/2/2018	Mr.P	60	S15060702250	44.25x79 45.50x169	44.00x80 45.50x170	0.25	0.21
20	3/1/2018	Mr.P	59	W1710123123	43.75x147 44.00x57	43.75x170 44.25x80	0.37	0.45
		Three Plane Group						
1	7/3/2018	Mrs.S	58		43.00X177 44.00X87	42.00X8 42.25X98	0.77	0.50
2.	7/3/2018	Mrs. SW	82	S1302007449	41.50X172 42.50X82	41.00X165 42.00X75	1.02	0.61
3	20/3/2018	Mrs.K	56	W1512080029	44.75X169 45.75X79	45.25X67 46.25X157	1.18	0.77
4	20/3/2018	Mr. S	58	S1312032015	43.25X91 44.25X1	42.50X87 44.25X177	0.77	1.02
5	7/3/2018	Mrs.K	62	1611102851	43.25X98 43.75X8 C-0.50X98	42.75X101 43.25X11 C-0.50X101	0.50	0.42
6	14/3/2018	Mrs.NY	45	W1803277430	47.25X77 48.25X167	47.50X63 48.00X153	0.75	0.50
7	14/3/2018	Mrs.K	45	W180427858	46.25x0 46.00x90	46.00x20 46.50x110	0.50	0.50
8	12/3/2018	Mrs.K	64	W1710124177	47.00X135 47.25X90	46.75X25 47.00X115	0.71	0.42
9	7/3/2018	Mrs.S	60	W1805279668	41.00X70 41.75X160	41.25X47 42.00X137	0.59	0.24
10	21/3/2018	Mrs.SU	56	W1804279763	43.50X111 44.75X21	42.50X88 44.25X178	1.26	1.05
11	21/3/2018	Mrs.K	54		44.50X22 43.25X202	43.75X175 42.25X136	1.14	0.77

Citation: Rini Kusumawar Dhany. "Comparison of Surgically Induced Astigmatism between Single Plane and Three Plane Incision Following Temporal Approach Phacoemulsification in Pre-Existing against-the-Rule Astigmatism Patients". *EC Ophthalmology* 10.5 (2019): 401-406.

12	21/3/2018	Mr.HD	68	W1803277373	42.50X85 44.00X175	42.75X64 44.25X154	1.08	0.51
13	21/3/2018	Mr.ST	53	W1802276042	43.25X17 43.75X107	42.50X94 43.25X4	1.22	1.22
14	3/2/2018	Mrs. S	47	S14080481333	43.25X83 44.25X173	42.50X91 44.25X1	0.77	1.02
15		Mr.M	55		42.75X89 44.75X179	43.50X90 45.00X180	0.50	0.31
16	3/2/2018	Mrs.HN	76	S1306019467	41.00X68 41.75X158	47.50X65 48.00X155	0.68	0.50
17	3/2/2018	Mr.S	59	W1712126512	43.25X90 44.25X0	46.75X23 47.00X113	0.75	0.42
18	3/2/2018	Mrs.K	74	W1601082025	41.00X69 41.75X159	47.50X62 48.00X152	0.59	0.50
19	19/2/2018	Mrs.K	65	W1804278581	46.00X103 47.00X13	45.50X89 46.00X179	0.61	0.61
20	19/2/2018	Mrs.KT	62	W1306019492	44.00X21 44.25X111	42.75X12 43.75X102	0.77	0.42

Table 2: Keratometry and SIA calculation pre and post-operative in both groups.

Discussion

Many of the more advanced cataract surgeons prefer a single-plane phaco incision because its consistent architecture makes for great sealing, but some surgeon has preference using three plane corneal incision to prevent post-operative wound leakage. Study about comparison of single plane and three plane corneal incision in phacoemulsification has not conducted yet. Total corneal astigmatism is the difference between steep and flat axis power. For example, if an eye has a keratometric power of 42 D at 180° and 41 D at 90°, the total astigmatism is the difference of 42.00 and 41.00, which equals 1 D of astigmatism. With the incision placed at the 180° position, and with the assumption that it will induce 0.5 D of flattening, the new keratometric values will be 41.75 D at 180° and 41.25 D at 90°, giving a total astigmatism of 0.5 D. Note that the average corneal power before the incision (41.50 D) is the same as the average corneal power after the incision (41.50 D), thus illustrating the corneal coupling effect. We can see in this example that patients who have ATR astigmatism will benefit from a reduction in corneal astigmatism due to placement of the phacoemulsification incision at this axis [7,8]. Temporal phacoemulsification incision reduces ATR astigmatism [9].

Based on this study result, the means difference of two groups seventh day and first month post phacoemulsification was statistically significant with p-value of 0.000 ($p > 0.05$) as obtained using independent t-test. This is in contrary with Colin et al study mentioned three plane corneal incision is significantly lower compared to a two plane incision [10]. The Collin study has less samples and based on wound construction, three planes corneal incision has prone to be poor construction because it more difficult to performed than single plane.

Conclusion

One plane incision significantly reduce corneal astigmatism compare with three planes incision. Further study with more samples is needed, with postoperative follow up on 3th month after surgery and exclusion criteria of diabetics and the difference between autorefractometer more than 0.5 D.

Declaration of Interest

The author reports no conflicts of interest. The author alone is responsible for the content and writing of the paper.

Bibliography

1. Borasio E., *et al.* "Torque and flattening effects of clear corneal temporal and on-axis incisions for phacoemulsification". *Journal of Cataract and Refractive Surgery* 32.12 (2006): 2030-2038.
2. Rainer G., *et al.* "Corneal shape changes after temporal and superolateral 3.0 mm clear corneal incisions". *Journal of Cataract and Refractive Surgery* 25.8 (1999): 1121-1126.
3. Woo SJ and Lee JH. "Effect of central corneal thickness on surgically induced astigmatism in cataract surgery". *Journal of Cataract and Refractive Surgery* 29.12 (2003): 2401-2406.
4. Collier Wakefield., *et al.* "Relationship between age, corneal astigmatism, and ocular dimensions with reference to astigmatism in eyes undergoing routine cataract surgery". *Eye (London)* 30.4 (2016): 562-569.
5. Ermiş SS., *et al.* "Surgically induced astigmatism after superotemporal and superonasal clear corneal incisions in phacoemulsification". *Journal of Cataract and Refractive Surgery* 30.6 (2004): 1316-1319.
6. Hamid Sajjadi and Mahyar Parvin. "Astigmatic Shift Following Sutureless, Triplanar, Curvilinear, Single Hinge, Clear Corneal Incision for Phacoemulsification and Intraocular Lens Implantation". *Ophthalmic Surgery, Lasers and Imaging Retina* 27.10 (1996): 844-848.
7. Tejedor J and Murube J. "Choosing the location of corneal incision based on preexisting astigmatism in phacoemulsification". *American Journal of Ophthalmology* 139.5 (2005): 767-776.
8. Koch D., *et al.* "Contribution of posterior corneal astigmatism to total corneal astigmatism". *Journal of Refractive Surgery* 38.12 (2012): 2080-2087.
9. Özkurt Y., *et al.* "Astigmatism after superonasal and superotemporal clear corneal incisions in phacoemulsification". *International Ophthalmology* 28.5 (2008): 329-332.
10. Colin SH Tan., *et al.* "Comparing Factors Affecting Surgically Induced Astigmatism After Phacoemulsification".

Volume 10 Issue 5 May 2019

©All rights reserved by Rini Kusumawar Dhany.