### Original article:

# The change of Astigmatism before and after phacoemulsification cataract surgery with temporal incision in senile cataract patients at RSUP Fatmawati year 2015 – 2016

AzhardinMaralaut<sup>1</sup>, Nida Farida<sup>2</sup>, Nurmila Sari<sup>3</sup>

### **Abstract**

Azhardin Maralaut Siregar. Medical Studies and Medical Eduaction Program. The change of Astigmatism Before and After Phacoemulsification Cataract Surgery with Temporal Incision in Senile Cataract Patients at RSUP Fatmawati year 2015-2016. Background: Cataract is a common disease in the elderly. Treatment of cataracts to date is by surgery, one of them with phacoemulsification technique, which is considered to have the best results because it gives the very small effect of change in astigmatism. Some of the factors that cause astigmatism change are the surgical techniques as well as the large and the location of the incision. Objective: To know the change of astigmatism in senile cataract patient before and after surgery with phacoemulsification technique at RSUP Fatmawati. *Method:* This research uses cross sectional design conducted in February 2017 until August 2017 at RSUP Fatmawati. The study used secondary data taken from a medical record of senile cataract patients who had undergone phacoemulsification technique surgery performed by one ophthalmologist in January 2015 to December 2016. Results: Respondents numbered 52 eyes from 52 patients aged ≥50 years. Analyzed using kolmogorov-smirnov test, it was found that the astigmatism change was not significant in the first week after surgery with p value 0.319, the insignificant astigmatism change in the third week after surgery with p value 0,505, the insignificant astigmatism change in the sixth week after surgery of astigmatism before operation with p value 0.311. But there was an increasing number of astigmatism patients from 32 (65%) to 39 patients (75%). Conclusions: There was an insignificant astigmatism change in the first, third and sixth weeks after phacoemulsification surgery of senile cataracts.

**<u>Keywords:</u>** Senile Cataract, Elderly, Phacoemulsification, Astigmatism, Before Surgery, After Surgery.

International Journal of Human and Health Sciences Vol. 05 No. 01 January '21 Page : 55-61 DOI: http://dx.doi.org/10.31344/ijhhs.v5i1.234

## **Background**

Cataract is the most common cause of blindness in the world (51%). In the year 2010, blindness occurred in 20 million people in the world due to cataracts. Meanwhile, in Indonesia, the prevalence of cataracts is 1.8%.<sup>1,2</sup>

Senile cataract is the clouding of the lens occurring above the age of 50 years, commonly affects both eyes and develops progressively or could not change within a long period of time. <sup>1</sup> This clouding of the lens results in a non-transparent

lens which interferes with the function of vision. According to the classification, it is divided into 4 stadiums, namely incipient, immature, mature, and hypermature.<sup>1,2</sup>

With the current increase in life expectancy in Indonesia, the incidence of cataracts will increase. This will disrupt a person's quality of life. Therefore, cataracts surgery is performed to improve the visual acuity (visus). For the management of cataracts, surgery could be performed with the Phacoemulsification technique.

- 1. Azhardin Maralaut, Medical Student of Fakultas Kedokteran Universitas Islam Negeri Jakarta, Ciputat, South Tangerang, Indonesia. azhardinm@gmail.com
- 2. Dr. Nida Farida, Sp.M, Lecturers, departement of ophtalmology, Faculty of Medicine, Syarif Hidayatullah Islamic State University, Jakarta, Indonesia. nida.farida@uinjkt.ac.id
- 3. Dr. Nurmila Sari, M.Kes Lecturers, departement of anatomy, Faculty of Medicine, Syarif HidayatullahIslamic State University, Jakarta, Indonesia. nurmila.sari@uinjkt.ac.id

<u>Correspondence to:</u> Azhardin Maralaut, Faculty of Medicine, Syarif Hidayatullah Islamic State University, Jakarta, Indonesia. **Email:** azhardinm@gmail.com

Phacoemulsification is a method of cataracts surgery using an ultrasonic vibrator to destroy the nucleus which is then aspirated through a 2.5-3mm incision. Then, foldable intraocular lenses are inserted. The advantages of surgeries with small incision are more stable surgery, faster recovery of visual acuity, minimized post-operative inflammation and post-operative astigmatism.

3,4,5 One of the successes of cataract surgery is based on the assessment of post-operative astigmatism. Astigmatism is a vision distortion caused by

Astigmatism is a vision distortion caused by variations of refractive powers on different meridians. The disorder occurs when some of the eye's refractive components are placed not in the middle, tilted, or not round. Many cases are caused by irregularity of the corneal arch, one of which is due to cataract surgery.<sup>1</sup>

Astigmatism after cataract surgeries is common, and severe astigmatism could interfere with visual acuity. Some of the factors which affect astigmatism are the size and the location of the incision during surgery. Generally, incisions made in cataract surgeries with phacoemulsification technique are through the temporal. The advantage of a temporal incision is easiness for the operator during surgery.

Phacoemulsification technique with temporal incision has been done for a long time at RSUP Fatmawati, but no research has been done on the change of astigmatism occurring after phacoemulsification cataract surgeries on patients of senile cataracts. Therefore, the researcher would like to research the change of astigmatism before and after phacoemulsification cataract surgery with temporal incision.

The objective of this research is to know the change of astigmatism in senile cataract patient before and after surgery with phacoemulsification technique at RSUP Fatmawati.

### 1. Research Method

The type of research used is an observational study with a cross-sectional descriptive approach to determine the differences in changes in the results of astigmatism before and after cataract surgery with Phacoemulsification surgery techniques in senile cataract patients. Data collection is done retrospectively by collecting secondary data in the form of patient medical records.

This research was conducted at RSUP Fatmawati from the month of May 2017. The data was taken from the medical records of senile cataract patients who had undergone cataract surgery with phacoemulsification technique during 2015-2016

by one ophthalmologist at RSUP Fatmawati.

Target population of this study is senile cataract patients who had undergone cataract surgery with phacoemulsification technique. Accessible population is senile cataract patients who had undergone cataract surgery with phacoemulsification technique by one ophthalmologist at RSUP Fatmawati during 2015-2016. The research samples taken are medical records which meet the inclusion criteria which have been determined by one doctor.

Samples of this study are senile cataract patients who had undergone cataract surgery with phacoemulsification technique with total sampling method and met the sample criteria. All members of the population were used as research samples as many as 52 people.

Inclusion criteria of samples

- □ Patients aged ≥50 years□ Diagnosed of senile cataracts
- ☐ Underwent
- Phacoemulsification surgery with incision of the temporal limbus area with single plane technique and installation of posterior eye chamber intraocular lens by an ophthalmologist at RSUP Fatmawati
- Available data of refraction examination before and after cataracts surgery with the best correction which refers to the auto refractometer examination Exclusion criteria of samples
- ☐ No available data of refraction examination before and after cataracts surgery
- ☐ Dislocation of intraocular lens
- □ ost-operative complications of cataract surgery in the anterior segment
- Eye diseases in the anterior segment such as abnormalities of the cornea
- Sutures at the incision site

## 2. Results and Discussion

#### Results

The number of respondents in this study were 52 patients aged  $\geq$  50 years. Respondents consisted of 12 patients (23.1%), classified as middle age (45-59 years), 31 patients (59.6%) classified as elderly (60-74 years), and 9 patients (17.3%) classified as late elderly (75-90 years). The age range of respondents is from 50 years to 79 years with an average age of 65.08 years (SD = 7,597). In this study, the majority of respondents were male. There were 30 male respondents (57.7%) and 22 female respondents (42.3%). The most common case is the right eye with 27 cases (51.9%) followed by the left eye with 25 cases (48.1%).

### **Distribution of Pre-Operative Astigmatism**

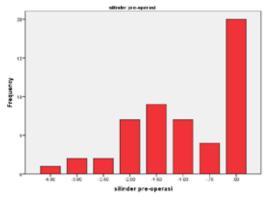


Figure 4.4. Distribution of astigmatism before phacoemulsification cataract surgery

Astigmatism before cataracts surgery ranged from -6.00 D to 0 D with an average (mean) of -1.048 D. Distribution of astigmatism before cataract surgery with most cases of astigmatism as many as 20 out 52 patients (38,5%). For astigmatism, most were -1.50 D as many as 9 patients, -2.00 D and -1.00 D as many as 7 patients each. Then, there were -0.75 D as many as 4 patients, -2.50 D and -3.00 D as many as 2 patients each. There was 1 patient with an astigmatism of -6.00 D and was the most severe case of astigmatism. From 32 patients with astigmatism, 23 patients had against-the-rule (axis  $90^{\circ} \pm 30^{\circ}$ ) astigmatism and 5 patients had with-the-rule ( $180^{\circ} \pm 30^{\circ}$ ) astigmatism.

## Distribution of Astigmatism on First Week Post-Operation

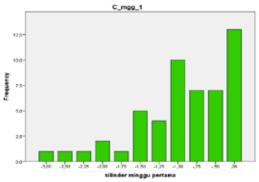


Figure 4.5.Distribution of Astigmatism one week after phacoemulsification cataracts surgery

Astigmatism on the first week after surgery ranged from -3.00 D to 0 D with an average (mean) of -0.861 D. Distribution of astigmatism within the first week after phacoemulsification cataracts surgery, most were still at 0 D (no astigmatism) with as many as 13 patients. An astigmatism measurement of -1.00 D was found in 10 patients. Figures -0.75 D and -0.50 D followed by, with as many as 7 patients each. Then, figures of -1.25 D

and -1.50 D were found in a total of 9 patients. 2 out of 52 patients had an astigmatism measurement of -2.00 D. Lastly, figures of -1,75 D; -2,25 D; -2,50 D; -3,00 D were found in 1 patient each. A total of 39 patients suffered from astigmatism.

# Distribution of Astigmatism on Third Week Post-Operation

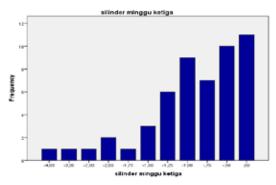


Figure 4.6. Distribution of Astigmatism three weeks after phacoemulsification cataracts surgery

Astigmatism on the third week after surgery ranged from -4.00 D to 0 D with an average (mean) of -0.894 D. Distribution of astigmatism within the third week after phacoemulsification cataracts surgery, most were still at 0 D with as many as 11 patients. Most cases of astigmatism above 0 D were at -0.50 D and -1.00 D with as many as 10 and 9 patients respectively. Then, an astigmatism measurement of -0.75 D was found in 7 patients. Followed by a measurement of -1,25 D in 6 patients. An astigmatism of -1.50 D was found in 3 patients and an astigmatism of -2.00 D was found in 2 patients. Lastly, figures of -1,75 D; -2,50 D; -3,00 D; -4,00 D were found in 1 patient each. A total of 41 patients suffered from astigmatism.

# Distribution of Astigmatism on Sixth Week Post-Operation

Astigmatism on the sixth week after surgery ranged from -3.00 D to 0 D with an average (mean) of -0.836 D. Distribution of astigmatism on the sixth week after phacoemulsification cataracts surgery, most were at 0 D with as many as 13 patients. Followed by measurements of astigmatism as severe as -0.50 D and -0.75 D found in a total of 16 patients. A measurement of -1.50 D was found in 8 patients. A measurement of -1.00 D was found in 6 patients. Astigmatism measurements of -1,25 D; -1,75 D; -2,00 D were found in a total of 6 patients. Astigmatism measurements of -0,25 D; -2,25 D; -3,00 D were found in a total of 3 patients. A total of 39 patients suffered from astigmatism.

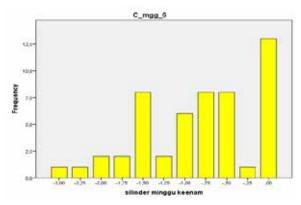


Figure 4.7. Distribution of Astigmatism six weeks after phacoemulsification cataracts surgery

# Comparations of Astigmatism Before and First Week After Cataracts Surgery with Phacoemulsification Technique

Table 4.4 Comparations of Astigmatism Before and on First Week After Senile Cataracts Surgery with Phacoemulsification Technique at RSUP Fatmawati in year 2015-2016.

Respondent	Categories	Frequency	Percentage	P	
Characteristics		(n)	(%)	value	
Astigmatism Before and	Decreases	23	44.3		
First Week After Cataracts Surgery	Increases	22	42.3	0,319	
	Constant	7	13,4		

23 out of 52 patients (44.3%) experienced a decrease of astigmatism on the first week. Meanwhile, 22 patients (42.3%) experienced an increase of astigmatism and 7 patients (13.4%) experienced no changes. A decrease of astigmatism indicated an improvement, but statistically this improvement is not significant with a p value of 0.319.

# Comparations of Astigmatism Before and Third Week After Cataracts Surgery with Phacoemulsification Technique

24 out of 52 patients (46.2%) experienced a decrease of astigmatism on the third week after operation. Meanwhile, 19 patients (36.5%) experienced an increase of astigmatism and 9 patients (17.3%) experienced no changes. Statistically, this improvement is not significant with a p value of 0.505.

Table 4.5 Comparations of Astigmatism Before and on Third Week After Senile Cataracts Surgery with Phacoemulsification Technique at RSUP Fatmawati in year 2015-2016.

Respondent	Categories	Frequency Percentage		P
Characteristics		(n)	(%)	value
Astigmatism	Decreases	24	46,2	
Before and Third Week	Increases	19	36,5	0,505
After Cataracts Surgery	Constant	9	17,3	

# Comparations of Astigmatism Before and Sixth Week After Cataracts Surgery with Phacoemulsification Technique

Table 4.6 Comparations of Astigmatism Before and on Sixth Week After Senile Cataracts Surgery with Phacoemulsification Technique at RSUP Fatmawati in year 2015-2016.

Respondent	Categories	Frequency	Percentage	P
Characteristics		(n)	(%)	value
Astigmatism	Decreases	23	44,3	
Before and Sixth Week	Increases	19	36,5	0,331
After Cataracts Surgery	Constant	10	19,2	

Respondent	Categories	Frequency	Percentage	P
Characteristics		(n)	(%)	value
Astigmatism	Decreases	13	25	
First Week and Sixth Week	Increases	10	19,2	0,842
After Cataracts Surgery	Constant	29	55,8	

Data showed that 23 out of 52 patients (44.2%) experienced a decrease of astigmatism on the sixth week. Meanwhile, 19 patients (36.5%) experienced an increase. The rest 10 patients (19.2%) experienced no changes. These changes, statistically, was not significant with a p value of 0.331. This is different from a previous research by Okky (2016) which stated that more experienced an increase of astigmatism between before and on the eighth month, as many as 55%, while decreases were only experienced by 25% and the rest 20% experienced no changes.<sup>6</sup> From the 23 patients who experienced a decrease of astigmatism, 18 patients had against-the-rule astigmatism before the operation.

# Comparations of Astigmatism on First and Sixth Week After Cataracts Surgery with Phacoemulsification Technique

Comparison of astigmatism between the first week and the sixth week showed a big frequency of constant astigmatism, as many as 29 out of 52 patients (55.8%). 13 patients (25%) experienced a decrease of astigmatism, while the rest 10 patients (19.2%) experienced an increase of astigmatism. This comparison, statistically, is also not significant with a p value of 0.679.

The average (mean) of pre-operative astigmatism was -1.05 D, after phacoemulsification surgery, the mean of astigmatism was -0.87 D on the first week, -0.89 D on the third week, and -0.86 D on the sixth week. This showed a change of astigmatism as large as -0.19 D within six weeks after operation, in accordance with another research which stated that temporal incision phacoemulsification technique with single plane incision gave the smallest impact on changes of astigmatism, ranging from 0 to 0.5 D.<sup>7</sup>

Table 4.7 Comparations of Astigmatism on First Week and Sixth Week After Senile Cataracts Surgery with Phacoemulsification Technique at RSUP Fatmawati in year 2015-2016.

Comparison of Total of Patients with Astigmatism Before and After Cataracts Surgery with Phacoemulsification Technique

Categories	Pre- Operation	%	First Week	%	Third Week	%	Sixth Week	%
Astigmatism	32	61,5 %	39	75 %	41	78,9 %	39	75%
No Astigmatism	20	38,5 %	13	25 %	11	21,1%	13	25%
Total	52	100 %	52	100 %	52	100%	52	100%

Table 4.8 Comparison of Total of Patients with Astigmatism Before and After Cataracts Surgery with Phacoemulsification Technique at RSUP Fatmawati in year 2015-2016.

There was an increase in total of patients with astigmatism after phacoemulsification surgery, from 32 patients to 39 patients on the first week, 41 patients on the third week, and 39 patients on the sixth week.

### Discussion

Surgically Induced Astigmatism (SIA) is the condition of astigmatism which is caused by operative measures. In cataract surgeries, an incision is made on the corneal limbus, this will affect the corneal curvature resulting in changes in astigmatism.<sup>6,8</sup>

The incision location will affect the corneal curvature. Dr. Howard Fine recommends a corneal incision in the temporal limbus because the horizontal diameter of the cornea is longer than the vertical diameter of the cornea, therefore the temporal limbus is further away from the visual axis compared to the superior direction. Corneal flattening due to this temporal incision will have less effect on the induction of astigmatism which occurs in the visual axis. An incision in the cornea will cause flattening in the direction opposite of the incision. Therefore, a corneal incision from the temporal tends to induce with-the-rule astigmatism. Conversely, a corneal incision from the superior tends to induce against-the-rule astigmatism. The amount of induction of this astigmatism depends on the length of the incision, the longer the incision, the greater the induction of the astigmatism.<sup>7</sup>

Apart from the length of the incision, the magnitude of the induction of astigmatism is

also determined by the architecture of the wound, where an architecture with a 3-angle incision (three plane incision) will cause a greater induction of astigmatism than a 1-angle incision (single plane incision). One-angle incisions are very good in terms of astigmatism induction with the minimum induction compared to other types of corneal incisions, between 0 to -0.50 D.<sup>7</sup>

This study observes the results of surgeriesdone by 1 operator doctor because the operator's experience will affect astigmatic results of surgery. In a study conducted by Xing Du et al, the incidence of post-phacoemulsification operative SIA was known to be associated with a post-operative corneal histocytological change. In phacoemulsification, significant corneal morphological changes occur. Xing Du et al. observed that the reduction in corneal endothelial cell density due to incision was directly related to the occurrence of SIA at 1 week, 2 weeks and 1 month postoperatively. The more severe the endothelial cell damage that occurs, the more severe the corneal oedema. This will cause changes in the corneal curvature, causing greater risk of developing an SIA. Therefore, this study concluded that it is important to protect endothelial cells from damage during cataract surgery.9

In this study, the majority of respondents were male. There were 30 male respondents (57.7%) and 22 female respondents (42.3%). In this study, it was found that most senile cataract patients were male. These results contrasts the research of Gricia et al. (2016) which stated that most patients of senile cataracts are women (55.4%) compared to men (44.6%).

From 52 respondents, 32 patients suffered from astigmatism and 20 patients did not suffer from astigmatism. From 32 patients with astigmatism, 23 of them had against-the-rule astigmatism (axis  $90^{\circ} \pm 30^{\circ}$ ) and 5 of them had with-the-rule astigmatism ( $180^{\circ} \pm 30^{\circ}$ ).

Statistically, there were no significant changes in astigmatism after phacoemulsification surgery in the first week (p value 0.319), the third week (p value 0.505) and the sixth week (p value 0.331). This is in contrast to the research of Okky(2016) which states that more experienced an increase in astigmatism before and in the eighth month by 55% while those who experienced a decreasewere only 25% and the remaining 20% remained constant. Out of the 23 patients who experienced

a decrease in astigmatism, 18 patients had against-the-rule astigmatism before the operation. This is consistent with Nikola Susic's statement, which states that a temporal incision will cause a With-The-Rule astigmatism. Therefore, in patients with Against-The-Rule astigmatism before the surgery with a temporal incision, the astigmatism will be reduced. This is consistent with research conducted by Nikola Susic (2007).<sup>10</sup>

Out of the 19 patients who experienced an increase of post-operative astigmatism, 16 patients had no astigmatism before the surgery, so the astigmatism occurred after surgery. 15 patients experienced against-the-rule astigmatism after surgery. The action of a temporal incision usually causes a with-the-rule astigmatism. It turns out that of the 15 patients who had Against-The-Rule on preoperative examination, most had poor visual acuity (4/60 - 5/30). Means that the cataract is thick so it is difficult to do a refraction correction carefully. It is possible that the patient had astigmatism but was not detected.

Changes of astigmatism in the first week after surgery compared to the sixth week after surgery were also statistically insignificant (p value 0.679). The average (mean) of pre-operative astigmatism was -1.05 D, after the phacoemulsification operation, the mean astigmatism of the first week becomes -0.87 D, the third week -0.89 D, and the sixth week -0.86 D. This shows a change of astigmatism as much as -0.19 D within 6 weeks after surgery, this is in accordance with other studies which state that the phacoemulsification technique of temporal incisions and single plane incisions gives the smallest impact on astigmatism changes, which is between 0-0.5 D.<sup>7</sup>

There was an increase in the number of patients with astigmatism after phacoemulsification surgery from 32 people to 39 people in the first week, 41 people in the third week, and 39 people in the sixth week.

#### 3. Conclusion

A research has been done on the changes of astigmatism on 52 patients with senile cataracts who underwent phacoemulsification cataract surgeries with temporal incision at RSUP Fatmawati throughout 2015-2016.

From this study, it could be concluded that, statistically, there were no significant changes in astigmatism before and after cataracts surgery with phacoemulsification technique, even though there were changes in numbers. In the comparisons, it is shown that the number of astigmatic patients increased from before surgery to the first week, third week, and sixth week after cataracts surgery. Phacoemulsification technique with temporal incision induced astigmatism with small diopters (-0.19 D), therefore it could be recommended as the best choice for cataract patients.

### **Limitations and Problems:**

Limitations and problems of this study include the lack of cooperation of employees in filling in the questionnaire, the lack of willingness to participate in the study, incomplete filling of the questionnaire, use of drugs for depression and those who were ingrief.

### **Ethical Approval:**

This research proposal was accepted by the Ethics Committee of Faculty of Medicine, Syarif Hidayatullah Islamic State University

Conflict of interest: None declared

### **Acknowledgement:**

We acknowledge and thank all people who dedicated their time and participated in this study.

#### **Author's Contributions:**

Data gathering and idea owner of this study:NF

Study design: AM
Data gathering: AM

Data analysis and consultation: NS Writing and submitting manuscript: NS

### **References:**

- Ilyas, Sidarta. 2015. *Ilmu penyakit mata*. Edisi 5. Jakarta: Balai Penerbit FKUI.
- 2. Vaughan G. D, Asbury T, Eva R.P. 2016. OftalmologiUmum. Edisi 17. Jakarta: EGC.
- A K Khurana. 2007. Comprehensive ophthalmology. Ed 4. India: New Age Internasional.
- Ocampo VV. Senile cataract. Internet. 2017 March 1 [cited on 2017 April 12. Available at <a href="http://emedicine.medscape.com/article/1210914-overview">http://emedicine.medscape.com/article/1210914-overview</a>
- 2. Kanski JJ and Bowling B. 2011. *Clinical ophthalmology: a systematic review.* USA: Elsevier
- Luntz M H, Livington D.G. Astigmastem in Cataract Surgery. British: Departemen of Ophtanology, Uniersiityof theWitwaterstrand and Johannesburg General Hospital, United Kingdom 1977.

- 4. Soekardi, Istiantoro. 2004. TransisiMenujuFakoemulsifikasi. Jakarta: Granit
- American Academy of Ophtalmology. Lens and cataract, basic and clinical science course. USA: AAO. 2011.
- Du X, Zhao G, Wang Q. Preliminary study of the association corneal histocytological change sand surgically induced astigmatism after phacoemulsification. BMC Ophthalmology. 2014; 14(134): 1-7
- Nikola S, Jasenka B, Ivana K. Analysis of Postoperative Corneal Astigmatism After Phacoemulsification Through A Clear Corneal Incision. Croatia: Department of Ophtalmology, Sibenik General Hospital, Sibenik, Croatia. 2007.

61