



Comparison of the Keratometric Value before and after Phacoemulsification of Senile Cataract through Clear Corneal Temporal Incision

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ABSTRACT

Introduction: Surgically induced astigmatism (SIA) is the most common complication after phacoemulsification. Astigmatism is caused due to the surgery related to the type and size of the incision and suture utilization. **Aim:** To study SIA caused by a clear corneal incision in phacoemulsification. **Method:** This is a design longitudinal prospective study. The senile cataract underwent phacoemulsification. Ophthalmologic evaluation included visual acuity, keratometry before and after phacoemulsification on the 7th and 30th day was observed. All operations were performed by one operator. **Result:** Total 60 patients (male 43.1%, female 56.9%) were included in the study. The mean age was 66.6 (range 44-84) years. The ATR (astigmatism against the rule) group consisted of 45 patients, and the mean keratometry on the 7th day was 0.412 D ($p=0.035$), and on the 30th day was 0.382 D ($p=0.052$). The AWR (astigmatism with the rule) group consisted of 20 patients, the mean keratometry on the 7th day was 0.384 D ($p=0.192$), and on the 30th day was 0.265 D ($p=0.333$). Post-operation, there were 43 patients in the ATR group, and 22 patients in the AWR group, the ATR group remain unchanged which consisted of 35 patients and AWR group included 12 patients have increased to 18 patients. Wilcoxon test analysis was used to analyze the patients, $p=0.637$, $\alpha=0.05$ this difference was not statistically significant. **Conclusion:** Keratometric change before and after phacoemulsification was not statistically significant.

Keywords: Keratometry, Phacoemulsification, Surgically induced astigmatism

INTRODUCTION

According to data from the Ministry of Health of the Republic of Indonesia in 2013, a cataract is one of the common issues which comprise of 1.8% of the population in Indonesia, and 1.4% in North Sumatera. Therefore, there is a shift in the ophthalmological paradigm from vision rehabilitation to the optimization of the function of the sight which aims to improve the quality of life [1].

The most common cataract surgery in Indonesia is the extracapsular cataract extraction (ECCE) with intraocular lens implantation. This conventional cataract surgery requires a 9-10 mm clear corneal incision, longer healing process and optimal visual acuity stabilization. On this basis, phacoemulsification may be advantageous because it can excrete cataracts by small incision of about 3.0 mm [2-4]. Small incision wounds to minimize the corneal curvatures changes after surgery, recovery and optical stabilization achieved immediately, which causes certainly less astigmatism [5].

The topographic component of the cornea is critical to the optical function, i.e. shape, curvature, and refractive power. The shape and curvature are the components of the geometric cornea and the refractive power as a functional component. Refraction power is the main parameter, the unit is diopter, and is considered as a basic examination unit.

PATIENTS AND METHODS

This study uses a longitudinal prospective design. Patients with senile cataracts have undergone phacoemulsification surgery at Rumah Sakit Khusus Mata Medan Baru, in March 2017. The patients with complicated cataract, previous surgery and eye trauma, and abnormalities involving corneas such as keratoconus, pterygium were included in the study.

In the examination of keratometry and biometry intraocular lens Carl Zeiss IOL Master® advanced technology version, 7.3 were used. In this study, the samples were grouped into two groups. First, astigmatism with the rule (AWR), a negative cylinder is on the horizontal axis and is in the meridian between 60-120 degrees. Second, astigmatism against the rule (ATR), a negative cylinder is on the vertical axis and is in the meridian between 1-30 degrees and 150-180 degrees.

As premedication, all patients were given tropicamide eye drops (mydriatil 1%; cendo), sodium diclofenac (flamar, Sanbe), and Ofloxacin (Floxa; Cendo). Anesthesia tetrakain was given before the eye drop (pantokain; cendo). The main incision was performed on the superotemporal clear cornea of about 0.5 mm from the limbus with a 2.2 mm keratome blade (Alcon). The viscoelastic material is injected into the anterior chamber, which is followed by a continuous curvilinear capsulorrhexis (CCC) to open the capsule. Then hydrodissection and lens mass aspiration were performed with a phacoemulsification machine (Alcon Infiniti® Vision System). Technically, phacoemulsification needs two stabs wound, one to do capsulorrhexis and another to insert the other instrument. A balanced salt solution was used for the irrigation of the anterior chamber. Implantation foldable intraocular lens is a hydrophobic acrylic aspheric manufactured by Alcon, Rayner, and Tecnis with an optical diameter of 6.00 mm and haptic length of 12.00 mm, which was inserted with an injector-cartridge system. Last, the viscoelastic material was irrigated and the wound incision was controlled with stromal hydration.

Follow-up was done after the surgery on the 1st day, 7th day, and 30th day. Patients receive eye drops, a combination of antibiotic ofloxacin and dexamethasone after every 3 hours for 7 days and in subsequent tapering off.

RESULTS

Total 60 patients were involved in the study with an average age of 66.6 years (range 44-84 years), which consisted of 43.1% male and 56.9% female. The rate of astigmatism was 46.2% in the right eye and 53.8% in the left eye.

Their visual acuity before phacoemulsification was $\leq 1/60$ in 24 people (36.92%), $\leq 3/60$ in 18 people (27.70%), $\leq 6/60$ in 18 people (27.70%), and $\leq 6/18$ in 5 people (7.69%). After phacoemulsification the visual acuity was 6/6-6/9 in 39 people (60%), 6/12-6/15 in 15 people (23.08%) and 6/18-6/30 in 11 people (16.92%).

In the ATR group before the operation, there were 45 patients. Afterward, on the 7th day an average change of a keratometric value of 0.412 diopters with $p=0.035$, and the 30th day of 0.382 diopters with $p=0.052$ was observed (Table 1).

Table 1 The differences of ATR group keratometry before and after phacoemulsification

Keratometric changes	ATR		Mean Difference	p-value
	n	x ± SD		
H0 ^a	45	1.239 ± 0.784	0.412	0.035
H7 ^a	45	1.651 ± 1.024		
H0 ^a	45	1.239 ± 0.784	0.382	0.052
H30 ^b	45	1.622 ± 1.038		

a: T-independent test; b: Mann Whitney test

The patients in the AWR group before operation were 20. Afterward, on the 7th-day operation found an average change of the keratometric value of 0.384 diopters with $p=0.192$, and on the 30th day, the keratometric value was 0.265 diopters with $p=0.333$ (Table 2).

Table 2 The differences of AWR group keratometry before and after phacoemulsification

Keratometric changes	ATR		Mean Difference	p-value
	n	x ± SD		
H0 ^a	45	0.923 ± 0.681	0.348	0.192
H7 ^a	45	1.271 ± 0.099		
H0 ^a	45	0.923 ± 0.681	0.265	0.333
H30 ^b	45	1.188 ± 1.001		

a: T-independent test; b: Mann Whitney test

Prior to phacoemulsification, the ATR group consisted of 45 respondents (69.23%) and the AWR group consisted

of 20 respondents (30.77%). After phacoemulsification, it counted 43 respondents (66.15%) in the ATR group and 22 respondents (33.85%) in the AWR group. Respondents who have same value keratometric before and after still remained in both the groups wherein ATR there were 35 respondents (53.85%) and in AWR there were 12 respondents (18.46). Total 18 respondents experienced a conversion from ATR to AWR, or vice versa (27.69%) (Table 3).

Table 3 Keratometric changes before and after phacoemulsification

Astigmatism changes	ATR		AWR	
	n	%	n	%
Increase	7	10.77%	7	10.77%
Decrease	8	12.31%	1	1.54
No Change	20	30.77%	4	6.15
Conversion	10	15.38%	8	12.31
Total	45	69.23%	20	30.77

The differences in the Bolton ratio: Negative Ranking is a conversion from the ATR group to AWR group. The positive ranking is a conversion from AWR group to ATR group. The ties mean keratometric value will not change before and after phacoemulsification, if previously it is the ATR group then there will be no change before and after the phacoemulsification it will still remain in the ATR group, and same goes for AWR (Table 4).

Table 4 Hypothesis test of keratometric differences before and after phacoemulsification

Astigmatism	Phacoemulsification			p-value
	Pre (N)	Post (N)	Alteration Rank	
ATR	45	43	Negative Rank	0.637
AWR	20	22	Positive Rank	
			Ties	
Total	65	65		

Wilcoxon test: The analysis was used to analyze the patients with no statistically significant difference ($p=0.637$, $\alpha=0.05$). It means H_0 accepted hypothetically, thus there was no difference in keratometric value before and after phacoemulsification through a clear corneal superotemporal incision which is statistically stated.

DISCUSSION

The initial cornea of the incision using long tunnel techniques, burning heat from the tip of phaco, and phaco hydration are the factors that cause complications in phacoemulsification. This results in endothelial damage and descemet detachment of 0.3% of the cases [6-8].

Comparative study of the clear corneal incision through steep meridian on phacoemulsification showed a keratometric average decreased by 1.31 ± 0.59 diopters in superior clear corneal incisions and 1.19 ± 0.64 diopters in temporal clear corneal incisions [9].

Research on the effects of incisions on phacoemulsification with a history of astigmatism was found that incision in steep meridian astigmatism was effective in reducing the history of astigmatism. The value of astigmatism before the operation was 1.90 ± 0.49 diopters with a range of 1.20 to 3.25 D. Astigmatism decreased in 92.92% of eyes, increased in 3.53% of eyes and remained in 3.53% of eyes. In this research, keratometric changes by 0.54 ± 0.27 diopters, which is statistically significant [10].

Anwar's study in 2014, compared astigmatism after phacoemulsification cataract extraction through a 3.2 mm superotemporal clear corneal incision. It was done on patients with an average age of 50 years (range 25-76 years). It was divided into 2 groups Group A astigmatism with the rule (AWR) and Group B astigmatism against the rule (ATR). Average astigmatism before phacoemulsification in Group A was 0.83 diopters and in Group B 0.76 diopters. In groups, A and B median astigmatism after phacoemulsification was 1.10 and 0.75 diopters, respectively. This means that there was an increase in astigmatism as much as 0.27 and 0.34 diopters. In Group A (AWR), there was an increase in astigmatism of 33.33% cases, 20% of cases remained unchanged, and 20% cases converted to ATR, 13.33% cases were neutralized, and 13.33% cases experienced a decrease in AWR. And in Group B (ATR), there was an increase in astigmatism of 62.50% cases, 9.37% cases remained unchanged, and 12.50% cases converted to AWR, 3.12% cases were neutralized and 12.50% cases experienced a decrease in ATR astigmatism [11].

Harakuni in 2016 conducted a study to evaluate the effect of surgically induced astigmatism (SIA) after phacoemulsification clear corneal incision placed in the steepest meridian in patients with a history of astigmatism. Before phacoemulsification, 50% of cases were of AWR and 50% of cases were of ATR. After phacoemulsification there has been a change in the proportion, AWR decreased to 40% of cases, ATR decreased to 30% cases, and 30% of cases were of no astigmatism. In the group initially AWR, after phacoemulsification 16% of cases remained unchanged, 18% of cases converted to ATR, and 14% cases were with no astigmatism. And in the ATR group 19% cases remained unchanged, 17% of cases converted to AWR and 16% of cases with no astigmatism. The average SIA was 0.54 ± 0.34 D, $p < 0.001$. SIA caused by superior incision was 0.84 ± 0.49 D and by temporal incision was 0.70 ± 0.35 D. Visual acuity examination on the 21st day after phacoemulsification was 25% (6/24-6/18), and 75% (6/12-6/6) [12].

The Rho's study in 2012 assessed surgically induced astigmatism (SIA) by a clear corneal incision on the steepest meridian. SIA in the temporal incision group was 0.28 ± 79 D, the superotemporal group was 0.40 ± 85 D, and the superior group was 0.46 ± 92 D [13].

The He's study concluded that the temporal clear cornea incision shows a smaller astigmatism keratometric change than the superior sclera incision. And no astigmatism keratometric difference was found after phacoemulsification between a 1st month and 3rd months [14,15].

The Joshi's study states that phacoemulsification does not alter corneal curvatures significantly and only very little induces astigmatism.

CONCLUSION

The superotemporal clear corneal incision is considered to be the most stable and leads to an increase in postoperative astigmatism of less than 0.50 D in long-term studies.

LIMITATIONS

This disadvantage of the study is the follow-up time to assess the effect of clear cornea incision with surgically induced astigmatism.

DECLARATIONS

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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