

Comparison of the Keratometric Before and After Phacoemulsification of Senile Cataract Through Clear Corneal Temporal Incision

Delfi, Wina Fuad Lubis

Department of Ophthalmology, University of Sumatera Utara

Abstract: ***Introduction:** Surgically Induced Astigmatism (SIA) is the most common complication after phacoemulsification involve cornea. Astigmatism due to surgery related to the type and size of the incision and suture utilization. **Purpose :** To study SIA caused by clear corneal incision in phacoemulsification. **Methods:** Design longitudinal prospective. Senile cataract underwent phacoemulsification. Ophthalmologic evaluation included visual acuity, keratometry before and after phacoemulsification in day 7 and 30. All operations were performed by one operator. **Result :** Sixty eyes patients (male 43.1%, female 56.9%). Mean age was 66.6 (range 44-84) years. ATR group 45 patients. Mean keratometry in day-7 is 0.412 D ($p=0.035$), and day-30 is 0.382 D ($p=0.052$). AWR group 20 patients. Mean keratometry in day-7 is 0.384 D ($p=0.192$), and day-30 is 0.265 D ($p=0.333$). Post operative in ATR group 43 patients and AWR 22 patients. Remain unchanged ATR 35 patients and AWR 12 patients, converted 18 patients. Wilcoxon test analysis $p=0,637 > \alpha = 0,05$, this difference was not statistically significant. **Conclusion:** Keratometric change before and after phacoemulsification not statistically significant.*

Keywords : keratometry, phacoemulsification, surgically induced astigmatism

1. Introduction

Cataracts in Indonesia, according to data from the Ministry of Health of the Republic of Indonesia in 2013 is 1.8%, while in North Sumatera 1.4%. Therefore, there is a shift in the ophthalmological paradigm from vision rehabilitation to the optimization of the function of sight, the goal is to improve the quality of life.¹

The most common cataract surgery in Indonesia is the extra capsular cataract extraction (ECCE) with intraocular lens implantation. This conventional cataract surgery require a 9-10 mm clear corneal incision, so longer healing process and optimal visual acuity stabilization. On this basis, phacoemulsification may be advantageous because it can excrete cataracts by smaller ones incision, about 3.0 mm.^{2,3,4} Small incision wounds to minimize corneal curvatures changes after surgery, recovery and optical stabilization achieved immediatly, certainly less astigmatism.⁵

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

2. Method

This study use a longitudinal prospective design. Patients with senile cataracts undergo phacoemulsification surgery at Rumah Sakit Khusus Mata Medan Baru, in March 2017. The exclusion criteria include complicated cataract, previous surgery and eye trauma, and abnormalities involving corneas such as keratoconus, pterygium, etc.

Examination of keratometry and biometry intraocular lens using Carl Zeiss IOLMaster® Advanced Technology v.7.3.

In this study, the samples were grouped into two groups. First, the astigmatism with the rule (AWR), negative cylindrical on the horizontal axis, is in the meridians between 60 - 120 degrees. Second, astigmatism against the rule (ATR), negative cylindrical on the vertical axis, is in the meridians between 1-30 degrees and 150-180 degrees.

As premedication, all patients were given tropicamide eye drops (Midriatil 1%; Cendo), sodium diclofenac (Flamar, Sanbe), and Ofloxacin (Floxa; Cendo). Previously given eye drop anesthesia tetrakain (Pantokain; Cendo). The main incision is performed on superotemporal clear cornea about 0.5 mm from the limbus with a 2.2 mm keratom blade (Alcon). Viscoelastic injection into anterior chamber, do continuous curvilinear capsulorrhexis (CCC), hydrodissection, and lens mass aspiration with phacoemulsification machine (Alcon Infiniti@Vision System). Technically, phaco need two stab wound, to do capsulorrhexis and insertion of second instrument. Irrigation of the anterior chamber using balanced salt solution. Implantation foldable intraocular lens is hydrohobic acrylic aspheris manufactured by Alcon, Rayner, and Tecnis. Optical diameter is 6.00 mm and haptic length is 12.00 mm, inserted with injector-cartridge system. Last, the viscoelastic material is irrigated and wound incision control with stromal hydration.

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

3. Result

The number of eyes as much as 65 eyes from 65 respondents. The average age is 66.6 years (range 44-84 years). Men 43.1% and women 56.9%. The right eye is 46.2% and the left eye is 53.8%.

There is 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 is 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%).

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

Keratometric changes	ATR n	ATR x ± SD	Mean Diff.	p.
H0 ^{a)}	45	1.239 ± 0.784	0.412	0.035
H7 ^{a)}	45	1.651 ± 1.024		
H0 ^{b)}	45	1.239 ± 0.784	0.382	0.052
H30 ^{b)}	45	1.622 ± 1.038		

Note : a) t-independent test, b)Mann Whitney test.

Patients in ATR group before operation is 45 respondents. Afterwards, in the 7th day found an average change of a keratometric value of 0.412 diopters with $p=0.035$, and the 30th day of 0.382 diopters with $p = 0.052$.

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

Perubahan Kornea	AWR		Mean Diff.	p.
	n	x ± SD		
H0 ^{a)}	20	0.923 ± 0.881	0.348	0.192
H7 ^{a)}	20	1.271 ± 0.0991		
H0 ^{b)}	20	0.923 ± 0.881	0.285	0.333
H30 ^{b)}	20	1.188 ± 1.001		

Note : a)t-independent test, b) Mann Whitney test.

The patients in the AWR group before operation is 20 people respondents. Afterwards, in the 7th day operation found an average change of keratometric value of 0.384 diopters with $p=0.192$, and in the 30th day of 0.265 diopters with $p = 0.333$.

Table 3: Keratometric Changes Before And After Phacoemulsification.

Perubahan Kornea	ATR		AWR	
	N	%	N	%
Meningkat	7	10.77	7	10.77
Meurun	8	12.31	1	1.54
Tetap	20	30.77	4	6.15
Konversi	10	15.38	8	12.31
Total	45	69.23	20	30.77

Prior to phacoemulsification, it counted ATR group 45 respondents (69.23%) and AWR group 20 respondents (30.77%). After that, it counted ATR group 43 respondents (66.15%) and AWR 22 respondents (33.85%). Respondents who has same value keratometric before and after, which is still ATR remained before and after as many as 35 respondents (53.85%) and respondents still remained AWR is 12 respondents (18.46). Respondents who experienced conversion ATR to be AWR, or vise versa, as many as 18 respondents (27.69%).

Table 4: Hypothesis Test of Keratometric Differences before and After Phacoemulsification

Astig	Fakoemulsifikasi		Perubahan Ranking	p.
	Pre N	Post N		
ATR	45	43	Ranking Negatif	0,637
AWR	20	22	Ranking Positif	
			Ties	
Jumlah	65	65		

The differences Bolton Ratio: Negative Ranking is conversion from ATR group to AWR group. Positive Ranking is conversion from AWR group to ATR group. The ties mean keratometric value will not change before and after phacoemulsification. If previous ATR then afterwards remain still ATR, and vice versa, if previous AWR then afterwards remain still AWR.

Wilcoxon test ; $p = 0.637 > \alpha = 0.05$. It means Ho accepted hypothetically, thus there is no differences keratometric changes before and after phacoemulsification through clear corneal superotemporal incision statistically stated.

4. Discussion

Complications of phacoemulsification caused by some factors, the initial cornea of the incision using long tunnel techniques, burning heat from the tip of phaco, and phaco hydration. This results in endothelial damage and descemet detachment of 0.3% of cases.^{7,8}

Comparative study of clear corneal incision trough steep meridian on phacoemulsification showed an keratometric average decreased by 1.31 ± 0.59 diopters in superior clear corneal incisions and 1.19 ± 0.64 diopters 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 were effective in reducing the history of astigmatism. The value of astigmatism before operation was 1.90 ± 0.49 diopters with a range of 1.20 to 3.25 D. Astigmatism decreased in 92.92% of eyes, still remained in 3.53% of eyes, and increase in 3.53% of eyes. In this research, it found keratometric changes by 0.54 ± 0.27 diopters, this amount is statistically significant.¹⁰

The Anwar's study (2014), comparing astigmatism after phacoemulsification cataract extraction through a 3.2 mm superotemporal clear corneal incision. It already done on patients with average age of 50.5 years (range 25-76 years). It was divided into 2 groups. Group A is Astigmatisma With The Rule (AWR) and group B Astigmatisma Against The Rule (ATR). The average astigmatism before phacoemulsification in group A was 0.83 was diotric and in group B 0.76 diopters. In groups A and B median astigmatism after phacoemulsification is 1.10 and 0.75 diopters, respectively. This means that there is an increase in astigmatism as much as 0.27 and 0.34 diopters. In group A (AWR), there is an increase in astigmatism of 33.33% cases, remained unchanged of 20%, and converted to ATR of 20% cases, neutralized of 13.33% cases, and experienced decreased AWR 13.33% cases. And in group B (ATR), there is an increase in astigmatism of 62.50% cases, remained

unchanged of 9.37% cases, and converted to AWR of 12.50% cases, neutralized 3.12%, and experienced decrease in ATR astigmatism of 12.50% cases.¹¹

Surgically induced astigmatism (SIA) by a clear corneal incision in the steep meridian in patients with a history of astigmatism by Harakuni (2016). Proportions before phacoemulsification, AWR is 50% cases and ATR 50% cases. After phacoemulsification there has been a change in the proportion, AWR to be 40% cases, ATR to be 30% cases, and no astigmatism 30% cases. In the group initially AWR, after phacoemulsification remained AWR 16% cases, 18% cases became ATR, and 14% cases were no astigmatism. And the group was originally ATR, then afterwards, 19% cases remained ATR, 17% cases became AWR, and 16% cases no astigmatism. The average SIA was 0.54 ± 0.34 D, $p < 0.001$. SIA caused by superior incision 0.84 ± 0.49 D and temporal incision 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 (2012) assessed surgically induced astigmatism (SIA) by a clear corneal incision on the steepest meridian. SIA in the temporal incision group 0.28 ± 0.79 D, superotemporal group 0.40 ± 0.85 D, and superior group 0.46 ± 0.92 D.¹³

The He's study (2009) 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 1 month and 3 months.¹⁴

The Joshi's study (2009) states that phacoemulsification does not alter corneal curvatures significantly and only very little induces astigmatism.⁶

The superotemporal clear corneal incision is considered to be most stable and leads to an increase in postoperative astigmatism of less than 0.50 D in long-term studies.^{11,15} This study has a disadvantage that is a follow-up time to assess the effect of clear cornea incision with surgically induced astigmatism.

References

- [1] Kemenkes RI-Balitbang. Riset kesehatan dasar : RISKESDAS. Jakarta: balitbang kemenkes RI. 2013.
- [2] Soekardi I, Hutahuruk JA. Transisi menuju Fakoemulsifikasi: langkah-langkah menguasai teknik dan menghindari komplikasi. Jakarta. Granit. 2004.
- [3] Drews RC. Five year study of astigmatic stability after cataract surgery with intraocular lens implantation: Comparison of wound sizes. J Cataract Refract Surg. 2000; 26: 250-3ey
- [4] Mamalis N. Incision width after phacoemulsification with foldable intraocular lens implantation. J Cataract Refract Surg. 2000; 26: 237-41.
- [5] Anwar, MS. Comparison of Pre and Postoperative Astigmatism after Cataract Extraction by Phacoemulsification through a 3.2 MM Clear Corneal Superotemporal Incision. Pak J Ophthalmol 2014, Vol. 30 No. 3.
- [6] Joshi MR, Shakya S. Change in refractive status of the patients undergoing phacoemulsification surgery. Nepal Med Coll J. 2009 Mar; 11(1):19-22.
- [7] Ali A, Tabassum A, Tahir A. Corneal problems during and after phacoemulsification by beginner phacoemulsification surgeon. Pak J Med Sci. 2007; 401-404.
- [8] Popiela G, Markuszewska J, Chelstowska J, Szalinski M. Analysis of phaco complications during mastering of the method. Klin Oczna 2004; 106(1-2):23-7.
- [9] Bazzazi N, Barazandeh B, et al. Opposite clear corneal incisions versus steep meridian incision phacoemulsification for correction of pre-existing astigmatism. J ophthalmic vis res. 2008; 3(2):87-90.
- [10] Khan A, Alam M, et al. Effect of incision site on pre-existing astigmatism in phaco-emulsification. Pak J ophthalmol 2014; 30; 1.
- [11] Anwar, MS. Comparison of Pre and Postoperative Astigmatism after Cataract Extraction by Phacoemulsification through a 3.2 MM Clear Corneal Superotemporal Incision. Pak J Ophthalmol 2014, Vol. 30 No. 3.
- [12] Harakuni Umesh, Meena A, Khanna A, Biala A. A longitudinal study to evaluate effect of surgically induced astigmatism after phacoemulsification clear corneal incision placed in the steepest meridian on eyes with preexisting astigmatism. Indian J Health. 2016; 9:179-84.
- [13] Rho CR, Joo CK. Effects of steep meridian incision on corneal astigmatism in phacoemulsification cataract surgery. J Cataract Refract Surg 2012; 38:666-71.
- [14] He Y, Zhu S, Chen M, Li D. Comparison of the keratometric corneal astigmatic power phacoemulsification : clear temporal corneal incision versus superior scleral tunnel incision. J of ophthal. 2009; 1-3.
- [15] Moon SC, Mohamed T, Fine IH. Comparison of surgically induced astigmatism after clear corneal incisions of different sizes. Korean J Ophthalmol. 2007; 21: 1-5