

Changes in Tear Film after Temporal Clear Corneal Incision Phacoemulsification

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ABSTRACT

The objective of this study is to analyze the differences of the tear film before and after phacoemulsification with temporal clear corneal incision. Thirty four eyes from 32 patients, who undergone phacoemulsification with temporal corneal incision were enrolled in this one group pre test and post test design cohort study. All subjects were measured for Tear Break Up Time, Fluorescein Staining Test and Schirmer I Test before surgery and on the day 1, day 7 and day 30 after phacoemulsification. This study included 18 men and 16 women, with age were all above 50 years. There were statistically decline in TBUT on day 1 (2.24 seconds) and day 7 (3.62 seconds) after surgery, compared to pre operative measurement (5.37 seconds) and increase to pre operative level on day 30 after surgery (5.24 seconds). Fluorescein Staining Test showed significant worsening of corneal score on day 1 (1) and day 7 (0.6) post operatively compared to the preoperative measurement (0), but getting better on day 30 (0.2), although never got back to pre operative level. For the Schirmer I test, statistically, there were significant rise on day 1 (15 mm) and day 7 (12 mm) after surgery and then declined to pre operative level (5.50 mm) on day 30 (6 mm) in conclusion. There were significant differences of the tear film before and after phacoemulsification.

Key words: tear film, phacoemulsification, cataract

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INTRODUCTION

Cataract is the major cause of blindness in the world and in Indonesia also, where it affects 1,78% of the population due to Riskesdas 2007, it means that it rises from 1,2% from Survey in 2001. Cataract can only be resolved by surgery at present and the small incision technique is increasingly popular.^{1,2} In 2005, *American Society of Cataract and Refractive Surgery* stated that phacoemulsification accounts for 73% of cataract surgery in United States.³ Some advantages of phacoemulsification are quick recovery of vision, relatively minimal astigmatism and post operative inflammation. But, after phacoemulsification, many patients complain of ocular dryness, burning, foreign body sensation or stickiness of the eyelid. It means that they suffer from dry eye syndrome, a condition that show a dysfunction of tear film that should provide protective function, nutrition supportive and ocular surface stability. Several factors known to exacerbate dry eye after phacoemulsification,

including disruption of corneal nerves with corneal incision, ocular toxicity of ophthalmic medications, perioperative medications including antibiotics, steroids and non steroids anti inflammation.

The aim of this study is to analyze the difference of the tear film before and after phacoemulsification by measuring TBUT, Fluorescein staining and Schirmer I test.

METHODS

The study design was longitudinal observational with one group pre test – post test design. Ethical approval for this study was obtained from Soetomo General Hospital ethics committee.

Thirty two patients (age 50–80 years, 18 males and 16 females) undergoing phacoemulsification at Soetomo General Hospital were recruited consecutively from March–September 2011, after obtaining signed consent.

Table 3. Corneal Staining Before and After Phacoemulsification

Corneal staining	Median (Min–Max)	p
Pre op	0 (0,00–1,00)	0.000*
Post op day 1	1 (0,40–3,00)	
Pre op	0 (0,00–1,00)	0.000*
Post op day 7	0,6 (0,00–3,00)	
Pre op	0 (0,00–1,00)	0.023*
Post op day 30	0,2 (0,00–3,00)	
Post op day 1	1 (0,40–3,00)	0.000*
Post op day 7	0,6 (0,00–3,00)	
Post op day 1	1 (0,40–3,00)	0.000*
Post op day 30	0,2 (0,00–3,00)	
Post op day 7	0,6 (0,00–3,00)	0.000*
Post op day 30	0,2 (0,00–3,00)	

*: p < 0.05 (significant)

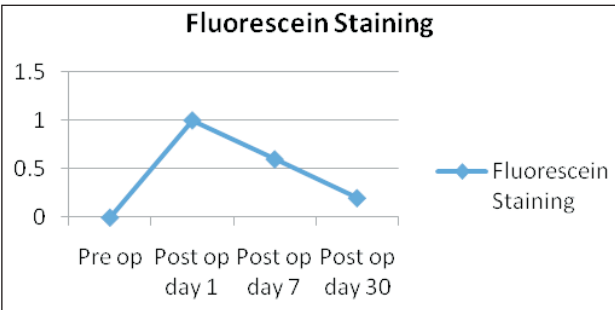


Figure 3. Ocular Surface Integrity Before and After Phacoemulsification

0.001) on day 30 after surgery, the same as pre operative level (p = 0.153).

In this study, we compare corneal staining before surgery and day 1, day 7 and day 30 after surgery. And the results was there were significant raise in corneal score between before surgery and day 1 (p = 0.000), day 7 (0.000) and day 30 after surgery (0.023).

Table 4. Schirmer Test Before and After Phacoemulsification

SIT	Median (Min–Max)	p
Pre op	5,50 (0,00–17,00)	0,000*
Post op day 1	15,00 (5,00–30,00)	
Pre op	5,50 (0,00–17,00)	0,000*
Post op day 7	12,00 (3,00–19,00)	
Pre op	5,50 (0,00–17,00)	0,693
Post op day 30	6,00 (0,00–15,00)	
Post op day 1	15,00 (5,00–30,00)	0,000*
Post op day 7	12,00 (3,00–19,00)	
Post op day 1	15,00 (5,00–30,00)	0,000*
Post op day 30	6,00 (0,00–15,00)	
Post op day 7	12,00 (3,00–19,00)	0,000*
Post op day 30	6,00 (0,00–15,00)	

*: p < 0.05 (significant)

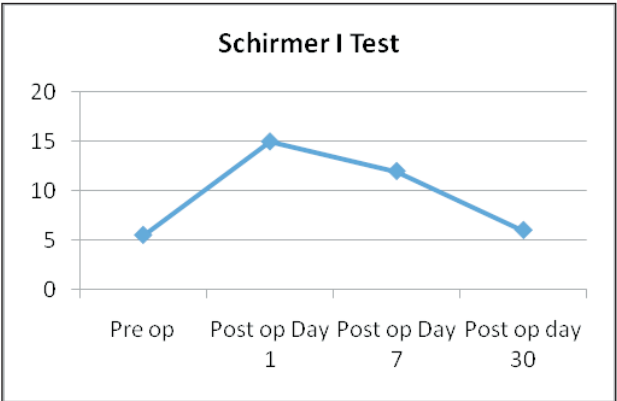


Figure 4. Tear Production Before and After Phacoemulsification

In this study also, we measured tear production using Schirmer I Test (SIT). And the result was there were statistically rise of SIT on the 1st day (p = 0.000) and 7th day (p = 0.000) after surgery compared to before surgery and going down to pre operative level on the 30th day after surgery (p = 0.693).

DISCUSSION

From 34 patients in this study, 18 (52.94%) were male and 16 (47.06%) were female. This results didn't matched with Beaver Dam Eye Study nor Blue Mountain Eye study which showed different distribution of sex, where female subjects was greater in number.⁶ It could be caused by there were 6 drop out subjects in this study and 5 of them were female. The age of the subjects were 8 subjects (23.53%) were 50–59 years old, 22 subjects (64.70%) were 60–69 years old and the rests were 4 subjects (11.77%) were 70–79 years old.

In this study, the TBUT was significantly decrease on 1st day after surgery compared to pre surgery and getting better on the 7th day and got back to pre operative level on the 30th day after surgery. All subjects in this study had abnormal TBUT (5,37 seconds, or under 10 seconds)⁷ and the age were all above 50 years old and according to Dry Eye WorkShop in 2007, dry eye syndrome prevalence was raised after the age of 50 years.⁸ Our result was similar with the studied conducted previously by Liu Z,⁹ Roberts *et al.*⁴ and Liu X.¹⁰ TBUT described the stability of the tear film, that consisted of lipid, aqueous, and mucine components. The stability could be disturbed if there were any changes in the tear film components. In phacoemulsification, there were some factors that influenced tear film stability. Phaco tip and light exposure could caused damage to ocular surface integrity. Surgery it self caused many inflammatory mediator release.^{1,9,11} Inflammation of the ocular surface was the key mechanism of ocular surface damage, as a cause and a result of cell damage. Ocular surface inflammation induced squamous metaplasia (changes from *wettablenonkeratinized epithelia* into *nonwettable*

keratinized epithelia), lost of glycocalyx and reduced Goblet cell density. Ocular surface inflammation also caused the ocular surface to become irregular, forming focal points that induced tear film break and tear film composition changes.¹²

In this study we also found that on the 30th day after surgery, the TBUT had reached pre operative level. It was similar with studies conducted by Liu X,¹⁰ Khanal *et al.*¹³ and Liu Z.⁹ But Sitompul *et al.* (2008) and Gharaee *et al.* (2009) showed different results, there was no significant difference in TBUT before and after phacoemulsification. It could be explained by the fact that on the 30th day the inflammation had decreased naturally or by medicamentous.^{1,14} Besides, in this study, the TBUT of all the subjects were abnormal that mean there was already an abnormality in their tear film and it meant that they were in a high risk of tear film disturbance.⁴

In this study, we also found that there was worsening in ocular surface integrity on 1st day after surgery compared to before surgery. And even it was getting better on the 7th day and 30th day, but it had never reached pre operative state. This result was similar with Liu Z (2002) and Liu X (2008), that showed significant rising fluorescein staining on the 1st day after surgery and gradually decreased to normal condition on 90th day after surgery.^{9,10} In phacoemulsification, there were some factors that causing damage of the corneal epithelia, ie corneal incision would induce a series of inflammation process that damaging corneal surface, corneal exposure to phacoemulsification tip and microscope light also causing ocular surface damage that in turn disturbed tear film stability.^{11,15} The use of topical eye drop perioperative, especially antibiotics and steroids, giving toxic effect to ocular surface,⁴ although in this study we used non preservative eye drop to minimize this effect. But, also in this study we could't use the same eye drop for all subjects. Some subjects were given polymyxin – neomycin – dexamethason eye drop (52.9%) and the rest (47,1%) were given tobramycin – dexamethason. The steroid component of the two kinds of drug had the same concentration: dexamethasone 1 mg/ml, and as the best of our knowledge there was no different of corneal toxicity effect of tobramycin and polymyxin – neomycin. And like had mentioned previously, all of the subjects in this study were above 50 years old. It mean that they had greater risk of having tear film disturbance and ocular surface damage. Also, in pre operative evaluation we had found that the Schirmer I Test were all less than normal (5.50 mm) and the TBUT were all also less than normal (5.37 seconds) that mean there were already abnormalities in the tear film of these subjects, so it raised the risk of the cornea to be damaged by all the factors mentioned above and the surgery intervention it self.

In this study, we realized there were many limitations. Phacoemulsifications were performed by more than one surgeon, the grade of lens opacity were not noted even though it could affected the difficulty and the ultrasound energy used. But, we had tried to control the bias

by limiting operating time, to reduced variability in corneal exposure to light microscope and phacoemulsification tip. We also conducted fluorescein staining in cornea area only, considered that in phacoemulsification, surgery intervention was limited in corneal area only, and differed from conventional ECCE or manual SICS where surgical intervention were performed more in conjunctival area, i.e. peritomy and cauterization. Although actually, with fluorescein we could also examined conjunctiva but since our facility didn't match the requirement of yellow filter, we didn't analyze conjunctival area. We choose fluorescein dye, due to recommendation of DEWS (2007) because it was relatively not irritative as Rose Bengal so it won't worsen inflammation process on ocular surface.

In this study, Schirmer I Test showed significant rises on the 1st day and 7th day after surgery compared to pre surgery, that decreased to pre operative level on the 30th day after surgery. This result was similar to studies by Sitompul *et al.* (2008), Liu X (2008) and Gharaee *et al.* (2009).^{1,11,13} It could happen because on the 1st day after surgery the tear production increased by irritation and inflammation that begin soon after the surgery started. Schirmer test here was the resultant of lacrimal gland production it self and influences of irritation and inflammation. As the time went by, irritation and inflammation decreased naturally and also there was the role of anti inflammation drug effect. So, later the Schirmer I test decreased to pre operative level. Actually, this result didn't match with the theory that mentioned a surgical intervention involving cornea would disrupt corneal nerves, causing decrease corneal sensitivity. In turn, it caused decreased of tear secretion by disrupting the nerve system loop in lacrimal functional unit.^{11,16,17} What happened in this study was an increased tear production, showed by raised Schirmer I Tes. It could be explained by the phenomenon of severe irritation and inflammation on the ocular surface within the early days after phacoemulsification that induce secretion of the lacrimal gland. As we know, the lacrimal functional unit, consisted of the lacrimal gland, ocular surface and the nervous system connecting them, in performing its function to manage the tear film quantity and composition, influenced by many factors such as local cytokine.^{12,18,19} So, corneal nerves was not the only factor playing a role in tear production. In this study also, corneal incisions were performed only in temporal side and it mean that corneal nerves in the other area were still intact, no altered function in conducting any stimulations from the ocular surface. Within first days after surgery, irritation and inflammation factors played more important role, it was showed by positive corneal staining and increased tear production in 1st day and 7th day after surgery compared to pre operative stage, but as time went by, it decreased naturally and by anti inflammation medication given after surgery and reached pre operative level on 30th day after surgery. But, we only observed until 30th day after surgery, so the condition after that day where inflammation factors became minimal and corneal sensitivity played more role

couldn't be observed. Beside that we didn't measure corneal sensitivity after surgery, so that we couldn't fully concluded whether inflammation or corneal sensitivity played greater role on tear film after surgery. And also we didn't evaluate the other components of tear film.

CONCLUSION

There were significant changes in tear film after phacoemulsification with temporal incision at day 1 and day 7. Prescribing artificial tears for the patients underwent phacoemulsification might be considered to relieve any dry eye syndrome-like symptom and improve the quality of life of the patients.

REFERENCES

1. Sitompul R, Sancoyo GS, Hutaaruk JA. Sensitivity Change in Cornea and Tear Layer due to Incision Difference on Cataract Surgery with Either Manual Small Incision Cataract Surgery or Phacoemulsification. *Cornea*. Lippincot Williams & Wilkins. Vol. 27. Suppl. 1. 2008. S13–S18.
2. Laporan Riset Kesehatan Dasar. Badan Penelitian dan Pengembangan Kesehatan. Departemen Kesehatan RI. 2008.
3. Devgan U. Dry-Eye Syndrome after Cataract Surgery. *Review of Ophthalmolgy*. 2005. p. 65–70.
4. Roberts CW, Elie ER. Dry Eye Symptoms Following Cataract Surgery. *The Journal of The American Society of Ophthalmic Registered Nurses*. Vol. XXXII (1). 2007.p. 14–23.
5. Lemp MA, Baudoin C, Baum J, Dogru M, Foulks GN, Kinoshita S, Laibson P, Mc Culley J, Murube J, Pflugfelder SC, Rolando M, Toda I. The Definition and Classification of Dry Eye Disease: Report of the Definition and Classification Subcommittee of International Dry Eye WorkShop.in 2007 Report of International Dry Eye WorkShop (Foulks GN, ed). *The Ocular Surface*. Vol. 5 (2) 2007.p. 75–91.
6. Kanthan GL, Wang JJ, Rochtchina E, Tan AG, Lee A, Chia EM, Mitchell P. Ten-Year Incidence of Age-Related Cataract and Cataract Surgery in an Older Australian Population, Blue Mountain Eye Study. *Ophthalmology* vol. 115. 2008. p. 808–814.
7. Kanski JJ. *Clinical Ophthalmology a Systematic Approach*, Elsevier Butterworth Heineman. 6th Ed. Toronto. 2007. p. 205–211.
8. Smith JA, Albeitz J, Begley C, Caffery B, Nichols K, Schaumberg D, Schein O. The Epidemiology of Dry Eye Disease: Report of Epidemiology Subcommittee of International Dry Eye WorkShop. *The Ocular Surface*. Vol. 5 (2). 2007. p. 93–107.
9. Liu Z, Luo L, Zhang Z, Cheng B, Zheng D, Chen W, Lin Z, Yang W, Liu Y, Zhang M, Xiao Q, Chen J. *Zhonghua Yan KeZaZhi*. Vol. 38 (2). 2002. p. 274–277.
10. Liu X, Gu YS, Xu YS. Changes of Tear Film and Tear Secretion after Phacoemulsification in Diabetic Patients. *Journal of Zhejiang University Science B* 9 (4). 2008.p. 324–328.
11. Kim JH, Chung JL, Kang SY, Kim SW, Seo KY. Change in Corneal Sensitivity and Corneal Nerve after Cataract Surgery. *Cornea*. Vol. 28. Suppl. 1. 2009. S20–25.
12. Johnson ME, Murphy PJ. Changes in the Tear Film and Ocular Surface from Dry Eye Syndrome. *Progress in Retinal and Eye Research*. Vol. 23. 2004. p. 449–474.
13. Khanal S, Tomlinson A, Esakowitz L. Changes in Corneal Sensitivity and Tear Physiology after Phacoemulsification. *Ophthal. Physiol. Opt.* Vol. 28. 2008. p. 127–134.
14. Gharaee H, Mousavi M, Daneshvar R, Hosseini M, Sazande S. Effect of Clear Corneal Incision Location on Tear Film following Phacoemulsification Surgery. *Iranian Journal of Ophthalmology* 21 (3). 2009. 29–34.
15. Cho YK, Kim MS. Dry Eye after Cataract Surgery and Associated Intraoperative Risk Factors. *Korean Journal of Ophthalmology*. Vol. 23. 2009. p. 65–73.
16. DeLeeuw AM, Chan KY. Corneal Nerve Regeneration, Correlation between Morphology and Restoration of Sensitivity. *Investigative Ophthalmology & Visual Science*, Vol. 30 (9). 1989.
17. Christopher YC, Chow JP, Gilbard. *Tear Film*. In *Cornea: Fundamentals of Cornea and External Disease* (Krachmer JH, Mannis MJ, Holland EJ, eds). Mosby. Inc. Vol. I. 2008.
18. Beuerman RW, Mircheff A, Plugfelder SC, Stern ME. The Lacrimal Functional Unit. in *Dry Eye and Ocular Surface Disorders* (Pflugfelder SC, Beuerman RW, Stern ME, eds). Marcel Dekker. Inc. Canada. 2004. p. 11–32.
19. Perry HD. Dry Eye Disease: Patophysiology, Classification and Diagnosis. *American Journal of Managed Care*. Vol. 14 (3). Suppl. 2008. S79–S87.