

**A COMPARATIVE STUDY OF TEAR FILM DYSFUNCTION AFTER SMALL
INCISION CATARACT SURGERY AND PHACOEMULSIFICATION**

Dr. Punit Singh¹, Dr Niklank Mehta², Dr Anjasi Patel³, Dr Bhoomi Thakkar⁴, Dr Robin Jain⁵,
Dr Janki Brahmhatt⁶.

Author's Affiliation

Associate Professor¹, 1st year resident², 3rd year resident³, 2nd year resident⁴, 2nd year resident⁵,
1st year resident⁶.

Corresponding Author

Dr. Niklank Mehta,
Second year Resident, Department of Ophthalmology,
SBKS MI&RC, Sumandeep Vidyapeeth deemed to be University
Piparia, Waghodia, Vadodara – 391760, Gujarat
drmehta005@gmail.com

ABSTRACT

Title: A Comparative study of tear film dysfunction after Small incision cataract surgery (SICS) and Phacoemulsification.

Aims: To study tear film dysfunction after Small Incision Cataract Surgery (SICS) and Phacoemulsification.

Settings and Design: Prospective Observational and Comparative study.

Materials and Methods: 164 patients that met the inclusion and exclusion criteria were enrolled into the study at the Department of Ophthalmology, Dhiraj Hospital Piparia, Waghodia, Vadodara, after getting approval from Ethics committee. 82 patients underwent SICS and other 82 underwent Phacoemulsification surgery. The dry eye parameters were evaluated preoperatively and thereafter on four follow ups: first post-operative day, seventh post-operative day, 1 Month and 3 Months to study the effect of cataract surgery on tear film. The data obtained was compiled and statistically analysed.

Results: Tear film dysfunction was most significant on first postoperative day and gradually came back to near normal values towards the last visit. At the end of 3 months, 21.95% and 8.54% of the patients in SICS and Phaco groups respectively had dry eye on the basis of Shirmer's - I test. Shirmer's II showed persistent dry eyes in 24.39% of the patients in SICS and 13.41% of the patients in the Phaco group. On the last visit, TBUT values in all 82 patients undergoing phaco were normal, Whereas TBUT remained abnormal in 2.44% of the patients in SICS group. TMH values were ineffective in determining tear film function.

Conclusion: Our study shows that tear film dysfunction occurs more after SICS than Phacoemulsification surgery. Modifying the risk factors associated with the surgical procedure and initiation of topical lubricating agents in the early postoperative period can minimize the incidence and duration of recovery of dry eye after cataract surgery.

Keywords: Dry eye, Tear film dysfunction, Cataract, SICS, Phacoemulsification.

Introduction

Senile cataract is the leading cause of treatable blindness and visual impairment all over the world. Cataract is said to cause 50% of the global blindness⁽¹⁾ and is inferred to account for vision impairment in more than 75 million people by 2020.

Dry eye after cataract surgery is a major cause of delay in visual rehabilitation post-operatively⁽²⁻⁵⁾. The size and site of the incision along with the operative time are considered vital amidst the several factors that govern the incidence and severity of dry eye after cataract surgery⁽⁶⁾.

Factors that are responsible for development of dry eye after cataract surgeries include prolong use of antibiotic-steroid eye drops, decrease tear film break-up time due to surface irregularity at the site of the incision, decrease mucin production from the conjunctiva secondary to incision placement, decrease corneal sensation due to surgical incision which disrupts the cornea-lacrimal gland loop leading to reduced tear secretion, poor tear film production and stability due to surgically induced ocular inflammation and exposure to light from the operating microscope.^(7,8,9)

Also various pre operative factors should also be considered such as various ocular and ocular surface pathology and systemic diseases that affects the treatment curve in a case of dry eyes. As the incision in manual cataract extraction procedure is larger compared to newer techniques deserving larger corneal tissue or any intra operative manoeuvre that damages corneal tissue can lead to poor prognostic outcomes of surgery and patient dissatisfaction.

There are various factors recognized to be associated with dry eye including aging, female gender, diseases of the ocular surface and adnexa; systemic diseases like diabetes mellitus, hypertension, connective tissue diseases; several systemic drugs and topical eye drops containing preservatives⁽¹⁰⁾.

A case-control study assessing the impact of dry eye symptoms on everyday activities found that patients with DES had difficulties with reading, carrying out professional work, watching television, and driving.⁽¹¹⁾ These studies illustrate how significantly dry eye symptoms can impact a patient's functioning.

The aims of this study were to identify the incidence of dry eye after cataract surgery and detect the pattern of dry eye after phacoemulsification and manual small incision cataract surgeries.

METHODS AND MATERIAL

Study setting

The study was conducted in Department of Ophthalmology, Dhiraj Hospital, SBKS Medical Institute and Research Centre, Piparia, Vadodara from September 2016 to April 2018.

Study design:

Prospective Observational and Comparative study

Sample size: 164 cases

Patient selection was random

Study population:

Total 164 patients requiring cataract surgery that visited Ophthalmology Department, Dhiraj hospital from the date of approval of the Ethics Committee till April 2018 were enrolled in the study. Out of all enrolled patients 82 underwent SICS and 82 underwent Phaco surgery based on the randomization procedure.

Study selection Criteria:

Inclusion criteria:

- Age group (≥ 50 years)
- Patient in need for cataract surgery performed under local anaesthesia

Exclusion criteria:

- Patients with pre-existing tear film dysfunction
- Anterior segment abnormalities
- Patients with glaucoma or uveitis
- Use of topical medication known to cause dry eye.
- Use of any systemic medication known to cause dry eye.
- Patients with ocular allergies
- Tested positive for human immunodeficiency virus (HIV)
- H/O rheumatoid Arthritis, sarcoidosis, or another collagen vascular disease.
- Females on HRT. (Hormone replacement Therapy)
- Patients that previously underwent any ocular surgery.

Method of data collection:

Patients of both gender (male, female) and age ≥ 55 years that visited Department of Ophthalmology were screened for the study with the aim to evaluate tear film dysfunction after cataract surgery. All the eligible study subjects were explained Patient Information sheet (PIS) in detail by the Principal Investigator (PI) in the language comfortable to the patient and sufficient time provided to the patient for making the decision to participate in the study. After patient's oral consent for the participation the study procedure was explained in a detailed fashion by the PI thereby taking the subject's signature on Informed Consent Form to confirm his participation in the study. After informed consent inclusion- exclusion criteria were reviewed and the following assessment was carried out.

Assessment of the patient:

A detailed ocular and medical history of the enrolled patient was taken followed by complete eye examination.

Visual parameters in accordance with the Study Proforma were recorded;

Uncorrected Visual Acuity (UCVA), Best Corrected Visual Acuity (BCVA) using Snellen's Visual Acuity Chart.

Complete anterior segment examination was done using slit lamp bio microscope with special attention to the tear film evaluation. The eyes were dilated with mydriatic drops. Lens grading was determined on the basis of LOCSIII grading on slit lamp bio microscope. Complete posterior segment examination was done using 90D lens on slit lamp biomicroscope.

Keratometry of both eyes was measured using auto refractometer.

Axial length (AL) and Anterior Chamber Depth (ACD) was measured of the eye chosen for surgery by A scan.

The intraocular lens (IOL) to be placed was calculated according to the K-values and corresponding AL using appropriate formulas depending upon the type of surgery chosen by the patient.

Enrolled subjects were admitted and routine blood investigations carried out. All the subjects underwent cataract surgery with SICS/Phacoemulsification with PCIOL implantation (PMMA, RYCF foldable lens, Acrysof IQ lens) under local anaesthesia. Whether the patient underwent SICS or Phacoemulsification was based on randomization.

The following tests were performed on all patients:

Schirmer's Test I: The tear strip was folded at the 0 mm mark and placed at the junction of the medial two thirds and lateral one thirds of the lower eyelids and allowed to stay in place for 5 minutes. A value of less than 15 mm in 5 minutes was taken as abnormal.

Schirmer's Test II: Topical anaesthesia by paracaine (0.5%) eyedrops was instilled in both eyes. Excess drops were wiped off from the inferior fornix. Tear strips were put for 5 minutes. A value of less than 15 mm in 5 minutes was considered abnormal.

Tear Film Break Up Time (TBUT): A Fluorescein strip after wetting with a drop of sterile saline, was applied in the inferior conjunctival cul-de-sac without the use of topical anesthesia. The patients were asked to blink for 3-4 times. The patient was asked to open their eyes and refrain from blinking while performing the test. The tear film was then examined using a broad beam of the slit lamp with the blue cobalt filtered light. The time lapse between the last blink to the appearance of the first random dry spot was taken as the tear film break up time. A value of less than 10 seconds was taken as abnormal.

The above tests were conducted at room temperature with fans switched off, and all readings were taken by a single observer.

Tear Meniscus Height (TMH):

TMH value was evaluated by measuring height of the tear lake resting at the junction of the bulbar conjunctiva and the lower eyelid margin and reading the scale on slit lamp biomicroscopy.

The patients were classified into two groups having TMH <1.0mm and >1.0mm.

Tear film function including tear film stability (tear film break-up time, TBUT) and tear secretion (Schirmer's I test, schirmer's II) and Slit lamp examination of the tear meniscus height was evaluated preoperatively and on post op day 1, 1 week, 4 week and 3 months postoperatively.

Result and statistical analysis:-

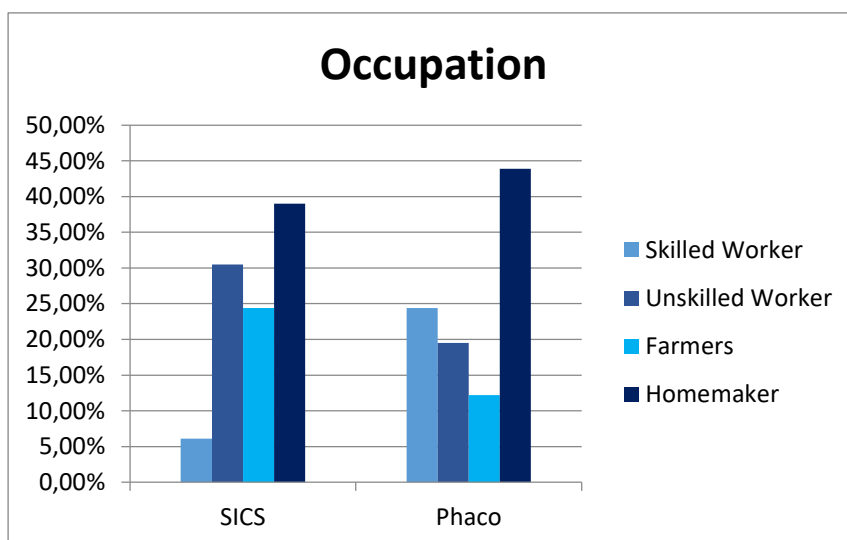
164 patients were selected on the basis of the inclusion and exclusion criteria of which 82 underwent SICS and 82 underwent Phacoemulsification. Their dry eye evaluation was done

using Schirmer's I test, Schirmer's II test, TMH evaluation for quantitative analysis of the tear film and TBUT for the qualitative analysis. The evaluation was performed preoperatively, and on follow ups at Post op day 1, Post op day 7, 1 month & 3 months.

Changes in tear film were evaluated in accordance of, occupation, history of addiction or substance abuse, size of the incision used intra-operatively.

OCCUPATION OF THE PATIENTS

Occupation	SICS	%	Phaco	%	Total	%	p value
Skilled Worker	5	6.10%	20	24.39%	25	15.24%	0.002
Unskilled Worker	25	30.49%	16	19.51%	41	25.00%	
Farmers	20	24.39%	10	12.20%	30	18.29%	
Homemaker	32	39.02%	36	43.90%	68	41.46%	
Total	82	100.00%	82	100.00%	164	100.00%	



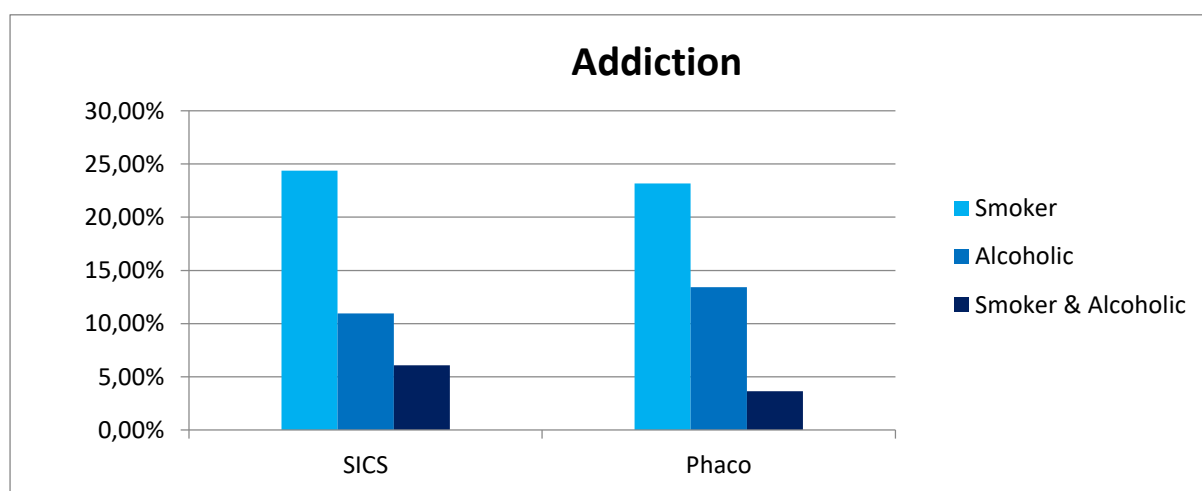
Majority of the patients that were operated were homemakers.. Of the patients undergoing SICS, 5 (6.10%) were skilled workers, 25 (30.49%) were unskilled workers, 20 (24.39%) were farmers and 32 (39.02%) were homemakers. From the phacoemulsification patients, 25 (24.39%) were skilled workers, 16 (19.51%) were unskilled workers, 10 (12.20%) were farmers and 36 (43.90%) were homemakers.

This distribution was stastically significant with a p value of 0.002.

ADDICTION PROFILE OF THE PATIENTS

Addiction	SICS	%	Phaco	%	Total	%
Smoker	20	24.39%	19	23.17%	39	23.78%
Alcoholic	9	10.98%	11	13.41%	20	12.20%
Smoker & Alcoholic	5	6.10%	3	3.66%	8	4.88%
None	48	58.54%	49	59.76%	97	59.15%
Total	82	100.00%	82	100.00%	164	100.00%

ADDICTION PROFILE OF THE PATIENTS



Amongst the patients undergoing SICS 20 (24.39%) were smokers, 9 (10.98%) were alcoholic, 5 (6.10%) were both smokers and alcoholics and 48 (58.54%) had no history of addiction. Out of the total patients undergoing phacoemulsification 39 (23.78%) were smokers, 20 (12.20%) were alcoholics, 3 (3.66%) gave a history of smoking and alcoholism and 97 (59.15%) had no addiction.

There was no statistical difference in the patients on the basis of history of addiction with a p value of 0.864.

**ASSOCIATION OF INTRAOPERATIVE SIZE OF THE INCISION AND DRY EYE
 IN SICS PATIENTS**

Size of Incision	Day	SICS	
		Dry Eye	%
5-5.5	Post op Day 1	1	1.22%
	Post op Day 7	0	0.00%
	Post op 1 month	0	0.00%
	Post op 3 months	0	0.00%
5.6-6.0	Post op Day 1	7	8.54%
	Post op Day 7	5	6.10%
	Post op 1 month	1	1.22%
	Post op 3 months	0	0.00%
6.1-6.5	Post op Day 1	18	21.95%
	Post op Day 7	14	17.07%
	Post op 1 month	5	6.10%
	Post op 3 months	3	3.66%
>6.5	Post op Day 1	40	48.78%
	Post op Day 7	35	42.68%
	Post op 1 month	26	31.71%
	Post op 3 months	14	17.07%

The patients undergoing SICS were divided into 4 groups on the basis of the size of the incision and the dry eye evaluated on consecutive followup as:

5-5.5 mm incision: 1.22% of the patients had dry eye on POD1 which returned to normal on the POD 7 onwards.

5.6-6.0 mm incision: Dry eye was seen in 8.54%, 6.10% and 1.22% of the patients on POD1, POD7 and 1 month followup returning back to normal at the end of 3 months.

6.1-6.6 mm incision: Dry eye was seen in 21.95%, 17.07%, 6.10% and 3.66% on all four visits.

>6.5mm incision: Dry eye was 48.78%, 42.68%, 31.71% and persisted in 17.07% patients at the end of the study.

**ASSOCIATION OF INTRAOPERATIVE SIZE OF THE INCISION AND DRY EYE
 IN PHACO PATIENTS**

Size of Incision	Day	PHACO	
		Dry Eye	%
2.8	Post op Day 1	55	67.07%
	Post op Day 7	45	54.88%
	Post op 1 month	35	42.68%
	Post op 3 months	15	18.29%
3.0	Post op Day 1	16	19.51%

	Post op Day 7	7	8.54%
	Post op 1 month	2	2.44%
	Post op 3 months	0	0.00%
3.2	Post op Day 1	3	3.66%
	Post op Day 7	1	1.22%
	Post op 1 month	0	0.00%
	Post op 3 months	0	0.00%

The patients undergoing phacoemulsification were divided into 4 groups on the basis of the size of the incision and the dry eye evaluated on consecutive follow up as:

2.8mm incision: 67.07%, 54.88%, 42.68% and 18.29% of the patients had dry eye on POD1, POD7, 1 month and 3 months follow up.

3.0mm incision: 19.51%, 8.54%, 2.44% returning to normal in all patients at 3 month visit.

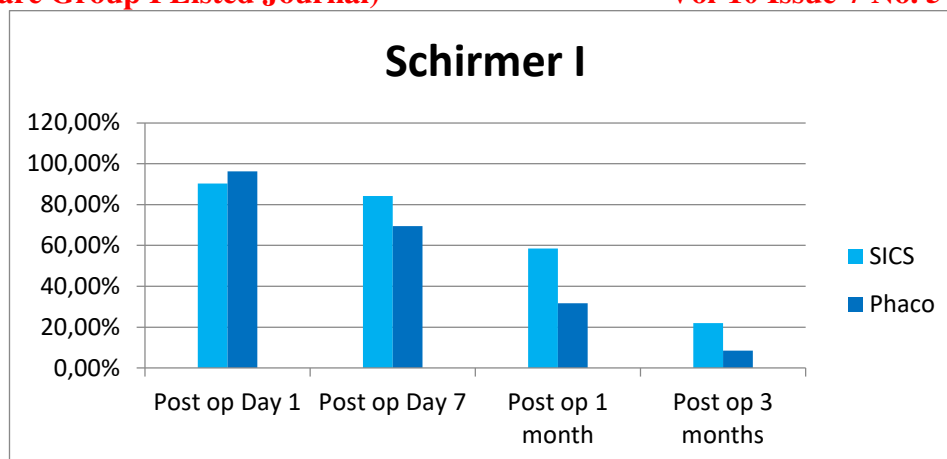
3.2mm incision: 3.66% on POD1 returning to normal at first postoperative month.

The results in the two groups were not comparable due to highly variable number of patients in each group.

TABLE-1: SCHIRMER I IN POST-OPERATIVE PATIENTS

Schirmer I	SICS		Phaco		p value
	Dry Eye	%	Dry Eye	%	
Post op Day 1	74	90.24%	79	96.34%	0.210
Post op Day 7	69	84.15%	57	69.51%	0.041
Post op 1 month	48	58.54%	26	31.71%	0.009
Post op 3 months	18	21.95%	7	8.54%	0.028

CHART: 1- SCHIRMER I IN POST-OPERATIVE PATIENTS

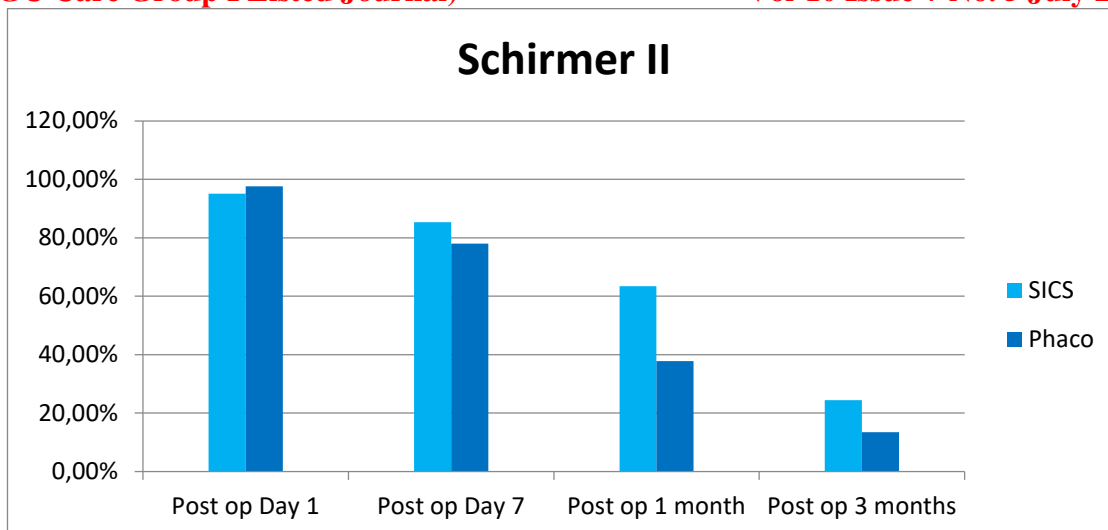


74 (90.24%) had dry eye on the first postoperative after SICS whereas 79 out of 82 (96.34%) had dry eye after phacoemulsification on the basis of the Schirmer I test. Phacoemulsification procedure causes more dry eye on the first post op day however, this difference was not statistically significant. Of the patients that underwent sics 69 (84.15%), 48 (58.54%) and 18 (21.95%) had dry eye on POD 7, 1 month and 3 months postoperatively. While the same in phaco group was 57 (69.15%), 26 (31.71%), and 7 (8.54%) respectively. This difference was statistically significant with a p value of 0.041, 0.009 and 0.028 on POD7, 1 and 3 months respectively.

TABLE 2: SCHIRMER II IN POST-OPERATIVE PATIENTS

Schirmer II	SICS		Phaco		p value
	Dry Eye	%	Dry Eye	%	
Post op Day 1	78	95.12%	80	97.56%	0.681
Post op Day 7	70	85.37%	64	78.05%	0.228
Post op 1 month	52	63.41%	31	37.80%	0.002
Post op 3 months	20	24.39%	11	13.41%	0.110

CHART 2: SCHIRMER II IN POST-OPERATIVE PATIENTS



The incidence of dry eye on the basis of Schirmer II test on POD1, POD7,1 and 3 months postoperatively was:

In SICS group: 78 patients (95.12%), 70 patients (85.37), 52 patients (63.41%) and 20 patients (24.39%)

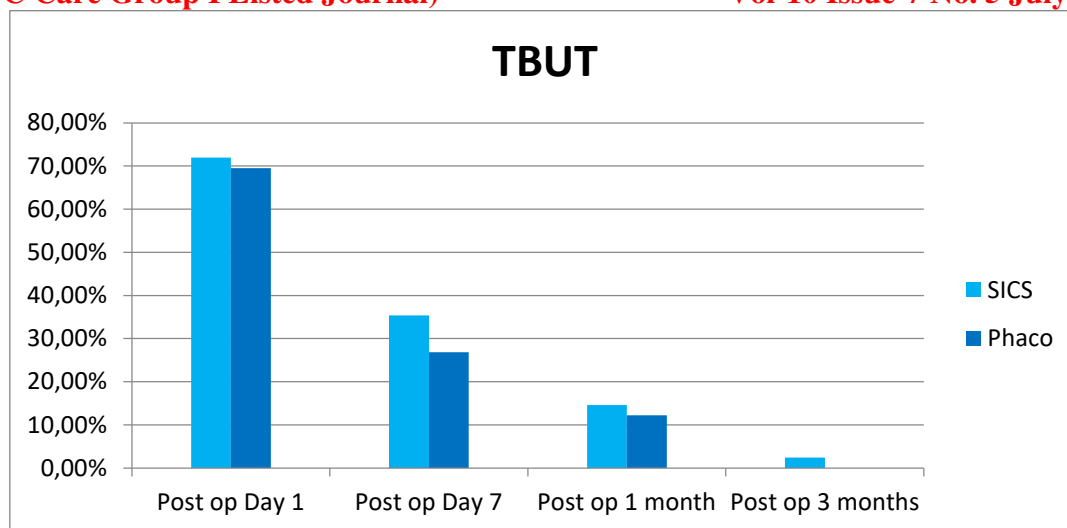
In phaco group: 80 patients (97.56%), 64 patients (78.05%), 31 patients (37.80%) and 11 patients (13.41%)

The dry eye on consecutive follow ups was more in the SICS patients as compared to phaco patients. However, this difference was significant only on first post-operative month with p value 0.002.

TABLE 3: CHANGES IN TBUT POSTOPERATIVELY

TBUT	SICS		Phaco	
	Dry Eye	%	Dry Eye	%
Post op Day 1	59	71.95%	57	69.51%
Post op Day 7	29	35.37%	22	26.83%
Post op 1 month	12	14.63%	10	12.20%
Post op 3 months	2	2.44%	0	0.00%

CHART 3: CHANGES IN TBUT POSTOPERATIVELY



Changes in the TBUT came back to normal limits in all the 82 patients at the 3 month follow-up, while 2 (2.44%) patients in the SICS group had abnormal TBUT levels even at the 3-month follow-up. The incidence of dry eye on all follow ups was more in the SICS group as compared to Phaco group but this difference was not statistically significant with a p value of 0.863, 0.312 and 0.819 on POD1, POD7 and 1 month postoperatively.

TABLE: 4 TEAR MENISCUS HEIGHT AND DRY EYE AMONGST PATIENTS UNDERGOING CATARACT SURGERY

TMH	SICS		Phaco	
	Dry Eye	%	Dry Eye	%
Post op Day 1	54	65.85%	50	60.98%
Post op Day 7	21	25.61%	15	18.29%
Post op 1 month	10	12.20%	9	10.98%
Post op 3 months	1	1.22%	0	0.00%

The Tear Meniscus Height was evaluated on slit lamp examination and documented as > 1.0mm (normal) and <1.0 mm (deficient) on Post op day 1, Post op day 7, 1 month and 3 months. The TMH in the patients that underwent SICS was deficient in 65.85%, 25.61%, 12.20% and 1.22% on the four consecutive follow ups. Whereas, in the patients undergoing phacoemulsification dry eye on the basis of TMH was seen in 60.98%, 18.29%, 10.98% on POD1, POD7 and 1 month respectively returning back to normal in all 82 patients at the end

of 3 months. However there was no statistically significant difference in the TMH values in two groups in all visits.

DISCUSSION

Cataract surgery has been said to affect both the qualitative and quantitative tear secretion. The incidence of dry eyes after cataract have been quoted to be as low as 9.8%⁽¹²⁾ to as high as 66.2%⁽¹³⁾. Dry eye after cataract surgery could be the result one of the two consequences: due to the aggravation of pre-existing dry eyes or surgically-induced dry eyes in patients devoid of dry eye preoperatively⁽¹⁴⁾ Tear film dysfunction after cataract surgery is a common entity associated with postoperative complaints like blurring of vision, foreign body sensation, redness and watering^(15,16)

In this study we evaluated the role of cataract surgery in causing dry eye and compared the same between the two surgical methods: SICS and Phacoemulsification. The age of the 164 patients was between 50 to 75 years with a mean age of 63.48 ± 8.25 years in SICS group and 61.75 ± 10.21 years in the Phaco group with no significant difference in the age distribution amongst the two groups.

Changes in tear film were evaluated in accordance of occupation, history of addiction substance abuse, size of the incision used intraoperatively.

In our study, the peak incidence of dry eye was seen on POD 1 showing a gradual reduction on each visit thereby. The incidence of dry eye was more in the Phaco patients as compared to those that underwent SICS however, this difference was not significant in the two groups on first day postoperatively. At the end of three months, 21.95% patients from the SICS group and 8.54% of the patients from the Phacoemulsification group had dry eye on the basis of Schirmer's I test (Table 1). Similar pattern was observed in Schirmer's II test also (Table 2). The overall disturbances in the quantitative evaluation of the tear film were more in the SICS group as compared to the phacoemulsification group on POD 7 (pvalue:0.041), 1 month (p value:0.009) and 3 months postoperatively (p value: 0.028).

The TBUT after cataract surgery is said to be affected more in the early postoperative period. This could be due to the irregularities in the healing cornea. A similar observation was made in our study. The TBUT was significantly lowered on POD1 and POD7. This came back to

normal in 85.37% of the SICS patients and 87.80% of the patients undergoing phacoemulsification at one month postoperatively with normal TBUT values on 3 month follow up in both groups. On comparison of the two groups the changes in TBUT was statistically insignificant (Table 3).

The Tear Meniscus Height (TMH) values were graded as <1.0mm and >1.0mm on all follow ups. The TMH was reduced in 65.85% of the SICS patients and 60.98% of the Phaco patients on POD 1 which returned to normal at the end of three months. According to the newer guidelines, dry eye is said to be significant when the TMH values are <0.25 mm. Due to the lack of availability of the required equipment a comprehensive TMH evaluation was not possible making the evaluation of dry eye inconclusive and incomparable to reference studies on the basis of this parameter in our study.

Altering the current surgical procedures in view of minimising the various risk factors associated with cataract surgery and the timely initiation of postoperative topical lubricating agents; the severity of dry eye post cataract surgery can be curtailed and the duration required for the tear film function to return back to normal can be minimised.

Financial Disclosures:

None

Conflicts of interests:

None

References:

1. Cent. Dis. Control. 1983. Cataract-a major blinding condition. *Morbid. Mortal. Wkly. Rep.* 32:119-20
2. Li XM, Hu L, Hu J, Wang W (2007) Investigation of dry eye disease and analysis of the pathologic factors in patients after cataract surgery. *Cornea* 26(9 suppl 1):S16–20.
3. Liu ZG, Li W. Dry eye relevant to ocular surgery. [Zhonghua yan ke za zhi] Chinese journal of ophthalmology. 2009 Jun; 45(6):483-5.
4. Ram J, Gupta A, Brar GS, Kaushik S, Gupta A (2002) Outcomes of phacoemulsification in patients with dry eye. *J Cataract Refract Surg* 28: 1386–9.
5. Dr Yusuf Rizvi, Dr Sneha Singh, Dr Ashutosh Dokania. Comparative assessment of tear function and ocular surface following cataract surgery employing manual SICS

- and phacoemulsification techniques. *Indian Journal of Basic and Applied Medical Research*; December 2014: Vol.-4, Issue- 1, P. 544-553
6. 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*. 2009 Jan 1;21(3):29-34.
 7. Sutu C., Fukuoka H., Afshari N.A. Mechanisms and management of dry eye in cataract surgery patients. *Curr Opin Ophthalmol*. 2016;27:24–30.
 8. Cho Y.K., Kim M.S. Dry eye after cataract surgery and associated intraoperative risk factors. *Korean J Ophthalmol*. 2009;23:65–73.
 9. Li X.M., Hu L., Hu J., Wang W. Investigation of dry eye disease and analysis of the pathogenic factors in patients after cataract surgery. *Cornea*. 2007;26(9 Suppl 1):S16–S20.
 10. Moss SE, Klein R, Klein BEK. Prevalence and risk factors for dry eye syndrome. *Arch Ophthalmol*. 2000; 118: 1264-1268.
 11. Gharaee H, Mousavi MN, Daneshvar R, Hosseini M, Sazande S. Effect of Clear Corneal Incision Location on Tear Film following Phacoemulsification Surgery. *Iranian Journal of Ophthalmology* 2009;21 (3):29-34
 12. Venugopal KC, Krishnaraj PA, Chandan N. Evaluation of Dryness of Eyes after Manual Small Incision Cataract Surgery with Corneoscleral Tunnel Incision. *J Clin Diagn Res*. 2012 Aug 1;6(6):1029-33.
 13. Sinha M, Sinha A, Chowdhury B. Comparative evaluation of dry eye following cataract surgery: a study from north india. *IOSR Journal of Dental and Medical Sciences*. 2014;13(6):13-8.
 14. Cetinkaya S, Mestan E, Acir NO, Cetinkaya YF, Dadaci Z, Yener HI. The course of dry eye after phacoemulsification surgery. *BMC ophthalmology*. 2015 Dec;15(1):68
 15. Li XM, Hu L, Hu J, Wang W (2007) Investigation of dry eye disease and analysis of the pathologic factors in patients after cataract surgery. *Cornea* 26(9 suppl 1)S16–20
 16. Roberts CW, Elie ER (2007) Dry eye symptoms following cataract surgery. *Insight32*: 14–21