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Comparative study of tear film abnormalities and dry eye conditions in ocular surface following phacoemulsification and small incision cataract surgery [SICS] A hospital based prospective study

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ABSTRACT

Background: To study ocular surface and tear film abnormalities in patients undergoing [PHACO] and [SICS]. [DED] is a disease of either tears or the ocular surface which leads to visual disturbance. SICS resulting in corneal hyposensitivity and reduction in reflex secretion and wound healing. PHACO is a contemporary cataract surgery in which the eyes internal lens is emulsified and aspirated from the eye using an ultrasonic handpiece.

Materials and Methods: A Hospital based prospective study involved 100 patients aged 40-65 years. 100 patients were subdivided into 2 groups, 50 members in each group. The observation of TBUT before surgery and after 1,3,6 months post-surgery were carried out in both group of patients.

Result: In this study 100 patients were subdivided into 2 groups, 50 members in each group as follows Group 1-50 patients scheduled for SICS with PCIOL implantation, Group 2-50 patients scheduled for PHACO with PCIOL implantation. Preoperatively the mean Schirmer value was 13.70 and 13.40 in patients underwent SICS and PHACO respectively. At postoperative 1 week, 89.1% of the group had grade 2 dry eye compared to 92.9% in the SICS group [p 0.0001].

Conclusion: Individuals with SICS had a higher prevalence and severity of dry eyes than those with PHACO.

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1. Introduction

Dry eye is a multifactorial ocular surface and tear illness that causes discomfort, visual disruption, tear film instability, and the possibility for ocular surface inflammation.¹

The prevalence of dry eye disease varies widely in population and hospital-based studies, ranging from 5% to as high as 73.5%.² Estimates suggest that dry eye affects approximately 7.4% to 33.7% of people.^{2,3} Dry eye disease (DED) incidence and prevalence after cataract surgery are

often underreported. The American Society of Cataract and Refractive Surgery (ASCRS) reported a DED prevalence of approximately 40% in cataract surgery patients, even though the symptoms may be transient, impacting the patient's quality of life.⁴

Small Incision Cataract Surgery (SICS) was originally developed in United States and Israel, but it has gained more popularity in India, where it accounts for accountable number of procedures. SICS, like other limbal relaxing incisions, can lead to corneal hyposensitivity and reduced reflex secretion due to nerve fiber injury.⁵ The

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prolonged surgical time and microscope exposure in SICS may exacerbate dry eye symptoms. Phacoemulsification is a modern cataract surgery technique involving the emulsification and aspiration of the eye's internal lens using ultrasonic technology.⁶

Common tests for diagnosing dry eyes include the Ocular Surface Disease Index (OSDI), Schirmer's tear test, and Tear Break-Up Time (TBUT). The OSDI is a questionnaire assessing dry eye symptoms and their impact on daily life. Schirmer's test-1 and TBUT are objective measures. Impression Cytology (IC) is used to assess ocular surface conditions in various dry eye disorders. It can aid in diagnosing ocular surface disorders, monitoring changes over time, and analyzing conjunctival squamous metaplasia. Dry eyes are a recognized postoperative complication of cataract surgery.⁷⁻⁹

Therefore, our study was performed about ocular surface and tear film abnormalities following phacoemulsification and manual small incision cataract surgery.

2. Materials and Methods

This was a hospital-based prospective comparative study with duration of 1 year in patients of age group 40-65 years with tear film abnormalities and dry eye conditions in ocular surface following phacoemulsification and small incision cataract surgery in Ophthalmology department of Vinayaka Mission's Kirupananda Variyar Medical College & Hospital, Salem and were enrolled in the study by obtaining written informed consent.

100 patients were screened in this study and were subdivided into 2 groups, 50 members in each group as follows:

Group 1: 50 patients scheduled for SICS with PCIOL implantation.

Group 2: 50 patients scheduled for phacoemulsification with PCIOL implantation.

The following ocular evaluation was conducted:

2.1. Pre-op evaluation

The patients' ocular history was collected, and they underwent visual acuity assessment with Snellen's chart, intraocular pressure measurement with Goldman's Applanation Tonometer, and Anterior segment examination using a slit lamp. Additionally, keratometry and axial length were measured, and IOL power was calculated using the SRK-T formula.

2.2. Dry eye parameters

1. TBUT
2. Schirmer's test-1
3. Rose Bengal staining
4. Van Bijsterveld scoring system

2.3. Post op evaluation

Post-operative evaluation was carried out during 1st month, 3rd month, and 6th month. Each evaluation included

1. Visual acuity - Snellen's chart
2. Slit lamp examination for anterior segment
3. Dry eye parameters: TBUT, Schirmer's test-1, Rose Bengal staining
4. Dry eye parameters: TBUT, Schirmer's test-1, Rose Bengal staining

2.4. Inclusion criteria

1. Patients in the age group of 40-65 years.
2. Patients have senile cataract.
3. Patients with cataract grade 1-4.

2.5. Exclusion criteria

1. Patients with age less than 40 years.
2. Patients with cataracts caused by an aetiology other than age, such as traumatic cataract, drug-induced cataract, radiation cataract, cataract due to chemical burns, complicated cataract, secondary cataract, congenital cataract, developmental cataract
3. Patients with cataracts above grade 5.
4. Patients having pre-existing ocular diseases.
5. Patients who are chronic contact lens users (>1 year).
6. Patients using bandage contact lenses.
7. Patients on chronic ocular medications.
8. Patients who have undergone corneal refractive surgeries, therapeutic surgeries, and graft surgeries.

2.6. Statistical analysis

Descriptive statistics was conveyed using mean and standard deviation for continuous variables. Categorical variables were mentioned as numbers and percentages. Parametric student t-test was used to compare the TBT and Schirmer's test between patients after phacoemulsification and manual SICS.

3. Results

In the present study, the mean age of the patients in both groups was almost 54.2 years in SICS and 55.06 years in the PHACO group (Figure 1). In both SICS and PHACO groups, most patients were male (SICS: 60%; PHACO: 64%).

The observation of TBUT before surgery (TBUT Preop) and after 1-, 3-, and 6-months post-surgery (TBUT postop) were carried out in both groups of patients. It was found that in both groups, TBUT postop was reported maximum after 6 months follow up (SICS: 19.84; PHACO: 22.12) (Figure 2).

Schirmer 1 test before surgery (Schirmer 1-preop) and after 1-, 3-, and 6-months post-surgery (Schirmer 1- postop)

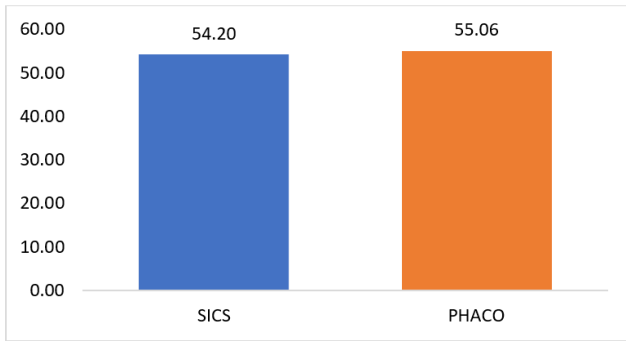


Figure 1: Mean age of patients in both groups

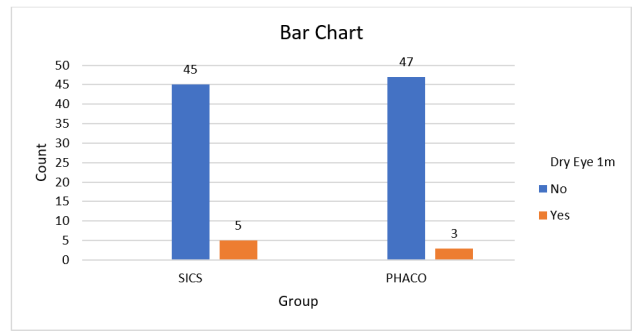


Figure 4: Observation of dry eye after 1 month of surgery in both groups

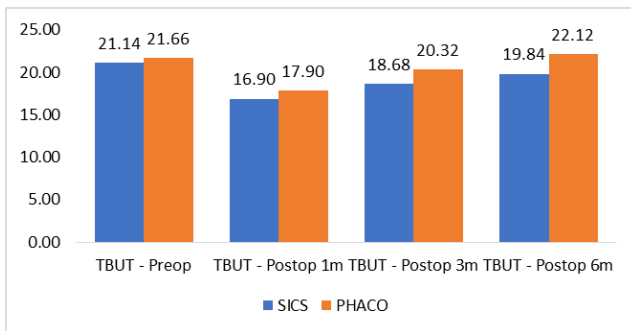


Figure 2: Observation of TBUT before and after surgery in both groups of patients

was also recorded in both patients. In both groups, Schirmer 1- postop was reported highest after a 6-month follow-up (SICS: 19.84; PHACO: 22.12), but it was less than the Schirmer 1-preop value (Figure 3).

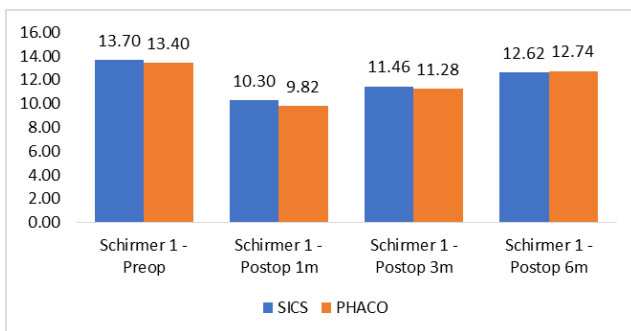


Figure 3: Observation of Schirmer 1 test values before and after surgery in both groups of patients

Dry eye observation was carried out after 1 M of surgery in both groups of patients. It was found that SICS reported 5 (10%) patients with dry eye, whereas the PHACO group recorded 3 (6%) patients with dry eye (Figure 4).

In SICS group patients, the mean TBUT- preop was reported to be 21.14, and the mean TBUT- postop 1M, 3M and 6 M was found to be 16.9, 18.68 and 19.84, respectively

(Table 1).

Table 1: Observation of mean TBUT-preop and TBUT-postop values in SICS group patients

	Mean	Std. Deviation	P value
TBUT - Preop	21.14	3.68	
TBUT - Postop 1m	16.90	4.36	<0.0001
TBUT - Postop 3m	18.68	4.33	
TBUT - Postop 6m	19.84	4.37	

Group= SICS

In SICS group, mean TBUT Preop values were studied against TBUT-Postop 1, 3, and 6M values. It was found that the maximum mean difference (4.24) was reported at 1-month values. TBUT-Postop 1M was studied against TBUT-Preop, TBUT- Postop 3 and 6M and a maximum mean difference (-4.24) was reported with TBUT-Preop. TBUT-Postop 3M was studied against TBUT-Preop, TBUT-Postop 1 and 6M and a maximum mean difference (-2.46) was reported with TBUT-Preop. However, when TBUT-Postop 6M was studied against TBUT-Preop, TBUT-Postop 1 and 3M and maximum mean difference (-1.3) was reported with TBUT-Preop (Table 2).

In PHACO group patients, mean TBUT-preop was reported at 21.66 and mean TBUT-postop 1M, 3M and 6 M were found at 17.9, 20.32 and 22.12, respectively (Table 3).

In the PHACO group, mean TBUT Preop values were studied against TBUT-Postop 1, 3, and 6M values. It was found that the maximum mean difference (3.76) was reported at 1-month values. TBUT-Postop 1M was studied against TBUT-Preop, TBUT-Postop 3 and 6M and a maximum mean difference (-4.22) was reported with TBUT-Postop 6M. TBUT-Postop 3M was studied against TBUT-Preop, TBUT-Postop 1 and 6M and a maximum mean difference (-1.8) was reported with TBUT-Postop 6M. However, when TBUT-Postop 6M was studied against TBUT-Preop, TBUT-Postop 1 and 3M and maximum mean difference (4.22) was reported with TBUT-Postop 1M (Table 4).

Table 2: Observation of mean difference between TBUT-preop and TBUT-postop among patients SICS group

TBUT		Mean Difference	P value
Preop	1 month	4.240*	<0.0001
	3 months	2.460*	<0.0001
	6 months	1.300*	<0.0001
1 month	Preop	-4.240*	<0.0001
	3 months	-1.780*	<0.0001
	6 months	-2.940*	<0.0001
3 months	Preop	-2.460*	<0.0001
	1 month	1.780*	<0.0001
	6 months	-1.160*	<0.0001
6 months	Preop	-1.300*	<0.0001
	1 month	2.940*	<0.0001
	3 months	1.160*	<0.0001

Table 3: Observation of mean TBUT-preop and TBUT-postop values in PHACO group patients

	Mean	Std. Deviation	P value
TBUT - Preop	21.66	3.55	<0.0001
TBUT - Postop 1m	17.90	3.96	
TBUT - Postop 3m	20.32	3.81	
TBUT - Postop 6m	22.12	4.00	

Group= PHACO

Table 4: Observation of mean difference between TBUT-preop and TBUT-postop among patients PHACO group

TBUT		Mean Difference	P value
Preop	1 month	3.760*	<0.0001
	3 months	1.340*	<0.0001
	6 months	-.460*	0.048
1 month	Preop	-3.760*	<0.0001
	3 months	-2.420*	<0.0001
	6 months	-4.220*	<0.0001
3 months	Preop	-1.340*	<0.0001
	1 month	2.420*	<0.0001
	6 months	-1.800*	<0.0001
6 months	Preop	.460*	0.048
	1 month	4.220*	<0.0001
	3 months	1.800*	<0.0001

In SICS group patients, the mean Schirmer 1-Preop was reported at 13.7, and mean Schirmer 1-postop 1M, 3M and 6 M was found at 10.3, 11.46 and 12.63, respectively (Table 5)

In SICS group, mean Schirmer 1- Preop values were studied against Schirmer 1-Postop 1, 3, and 6M values. It was found that the maximum mean difference (3.4) was reported at 1-month values. Schirmer 1-Postop 1M was studied against Schirmer 1-Preop, Schirmer 1-Postop 3 and 6M and a maximum mean difference (-3.4) was reported with Schirmer 1-Preop. Schirmer 1-Postop 3M was studied against Schirmer 1-Preop, Schirmer 1-Postop 1 and 6M

Table 5: Observation of mean Schirmer 1-preop and Schirmer 1-postop values in SICS group patients

	Mean	Std. Deviation	P value
Schirmer 1 - Preop	13.70	2.20	<0.0001
Schirmer 1 - Postop 1m	10.30	1.66	
Schirmer 1 - Postop 3m	11.46	1.63	
Schirmer 1 - Postop 6m	12.62	1.69	

Group= SICS

and a maximum mean difference (-2.24) was reported with Schirmer 1-Preop. However, when Schirmer 1-Postop 6M was studied against Schirmer 1-Preop, Schirmer 1-Postop 1 and 3M and maximum mean difference (-1.08) was reported with Schirmer 1-Preop. (Table 1)

Table 6: Observation of mean difference between Schirmer 1-preop and Schirmer 1-postop among patients SICS group

Schirmer 1		Mean Difference	P value
Preop	1 month	3.400*	<0.0001
	3 months	2.240*	<0.0001
	6 months	1.080*	0.001
1 month	Preop	-3.400*	<0.0001
	3 months	-1.160*	<0.0001
	6 months	-2.320*	<0.0001
3 months	Preop	-2.240*	<0.0001
	1 month	1.160*	<0.0001
	6 months	-1.160*	<0.0001
6 months	Preop	-1.080*	0.001
	1 month	2.320*	<0.0001
	3 months	1.160*	<0.0001

In the PHACO group patient's mean Schirmer 1-Preop was reported at 13.4, and mean Schirmer 1-Postop 1M, 3M and 6 M was found at 9.82, 11.28 and 12.74, respectively (Table 7)

Table 7: Observation of mean Schirmer 1-preop and Schirmer 1-postop values in PHACO group patients

	Mean	Std. Deviation	P value
Schirmer 1 - Preop	13.40	2.05	<0.0001
Schirmer 1 - Postop 1m	9.82	1.85	
Schirmer 1 - Postop 3m	11.28	1.70	
Schirmer 1 - Postop 6m	12.74	1.82	

Group = PHACO

In the PHACO group, mean Schirmer 1- Preop values were studied against Schirmer 1-Postop 1, 3, and 6M values. The maximum mean difference (3.58) was found at 1-month values. Schirmer 1-Postop 1M was studied against Schirmer 1-Preop, Schirmer 1-Postop 3 and 6M and the maximum mean difference (-3.58) was reported with Schirmer 1-Preop. Schirmer 1-Postop 3M was studied against Schirmer

1-Preop, Schirmer 1-Postop 1 and 6M and a maximum mean difference (-2.12) was reported with Schirmer 1-Preop. However, when Schirmer 1-postop 6M was studied against Schirmer 1-Preop, Schirmer 1-postop 1 and 3M and maximum mean difference (2.92) was reported with Schirmer 1-postop 1M (Table 8)

Table 8: Observation of mean difference between Schirmer 1-preop and Schirmer 1-postop among patients PHACO group

Schirmer 1		Mean Difference	P value
Preop	1 month	3.580*	<0.0001
	3 months	2.120*	<0.0001
	6 months	.660*	0.020
1 month	Preop	-3.580*	<0.0001
	3 months	-1.460*	<0.0001
	6 months	-2.920*	<0.0001
3 months	Preop	-2.120*	<0.0001
	1 month	1.460*	<0.0001
	6 months	-1.460*	<0.0001
6 months	Preop	-.660*	<0.0001
	1 month	2.920*	<0.0001
	3 months	1.460*	<0.0001

4. Discussion

In our study, mean age in both groups was almost 54.2 years in SICS and 55.06 years in the phacoemulsification group. In addition, both SICS and phacoemulsification groups majority of patients were male (SICS: 60%; phacoemulsification: 64%), and the proportion of both genders was reported to be comparable.¹⁰ Ishrat et al., found that baseline characteristics were comparable among the study participants.¹¹

Dry eye observation was carried out after 1 month of surgery in both groups of patients. It was found that SICS reported 5 (10%) patients with dry eyes, whereas the phacoemulsification group recorded 3 (6%) patients with dry eyes. In the study by Saif et al. they showed improvement in dry eye with time for both groups (SICS and phacoemulsification), it was reported in patients after a 3 months follow-up.¹²

Cho and Kim reported that dry eye symptoms and diagnostic test findings worsened after cataract surgery, aligning with this investigation's findings.¹³ Ishrat et al. also noted significant TBUT changes at 1 and 3 months post-surgery, consistent with our study. Early postoperative results showed a significant decrease in TBUT at 1 month compared to preoperative data, with the SICS group experiencing a more pronounced reduction. This difference persisted at the 3-month and 6-month follow-ups.¹¹

Preoperatively, Group 1 (SICS) had a mean Schirmer1 value of 13.70, while Group 2 (Phacoemulsification) had a

mean value of 13.40. After surgery, Group 2 experienced a more significant reduction in mean Schirmer1 values than Group 1 at 1 month. A similar pattern was observed in the phacoemulsification group when comparing Schirmer1 mean difference values.¹⁴

Other studies by Oh et al., Shrivastava et al., and Ishrat et al. reported variations in Schirmer1 values postoperatively. They found that Schirmer 1 scores improved at 1 and 3 months but remained below baseline. At one week, Ishrat et al. reported Schirmer1 scores of 19.1 ± 0.89 mm in the SICS group and 20.7 ± 0.81 mm in the phacoemulsification group.^{11,14,15} Shrivastava et al. noted significant changes in Schirmer1 values from preoperative to day 7 and day 21, but by day 90, the values had returned to preoperative levels with no significant difference.¹⁵

In the study conducted by Garg et al.⁴ findings were associated with higher cases of dry eye in the SICS (at 1 week 92.9% & at 1 month 26.8%) when compared to phacoemulsification (at 1 week 89.1% & at 1 month 15.6%) followed by one week after surgery, patients had grade 2 dry eye about 89.1% & 92.9% in both the groups respectively with ($p < 0.0001$). After 1 month follow up, about 92.2% in phacoemulsification group had grade 0 dry eye, 7.8% had grade 1 & none with grade 3 dry eye. This was statistically significant with $p < 0.0001$.

Similarly, it was determined that individuals who underwent SICS had a higher prevalence and severity of dry eyes compared to those who had phacoemulsification surgery. Other studies have also indicated that the size of the incision is correlated with the severity and duration of dry eye.¹⁴

5. Conclusion

Prevalence of symptoms of dry eye are common following cataract surgery. The Schirmer's test 1 remains normal postoperatively but TBUT is low in the first month of postoperative period. However, the dry eye disease is not a chronic problem and resolves within 6 months post-surgery.

6. Source of Funding

None.

7. Conflicts of Interest

The author's declare nil conflicts of interest.

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