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OCULAR SURFACE AND TEAR FILM ABNORMALITIES POST CATARACT SURGERY- SICS V/S PHACOEMULSIFICATION

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ABSTRACT

Introduction: Dry eye is a multifactorial ocular surface and tear film disorder that causes discomfort, visual disruption and tear film instability, as well as potential ocular surface injury[1]. Our aim is to evaluate and compare the ocular surface and tear film changes following cataract surgery- Small Incision Cataract Surgery (SICS) V/S Phacoemulsification surgery

Methods: Patient diagnosed with cataract, age >40 years were selected. A detailed history and ocular examination were done. Patients explained the purpose and procedure of the study.

A written consent was taken. Patients were divided into 2 groups Group 1 included all cases who underwent SICS and Group 2 included all cases who underwent Phacoemulsification. Preoperatively Schirmer's test, TBUT, OSDI, Impression cytology were done on patients and details were recorded in preformed proforma. Patients underwent their respective surgery. Post operatively Schirmer's test, TBUT, OSDI, Impression cytology were done at 1 week, 1 month and 3 month and details were recorded in preformed proforma.

Result: Individuals who underwent SICS had a higher prevalence and severity of dry eyes in early post operative period than those who underwent phacoemulsification surgery.

Conclusion: To conclude dry eye is known to have various etiological factors out of which cataract surgery is one of the factors predisposing to dry eye. Incidence of dry eye is higher in Small Incision Cataract Surgery (SICS) than phacoemulsification due to tear film instability. Eyes with post operative dry eye may also have lesser visual comfort as compared to those who do not develop significant dryness.

Keywords: dry eye, tear film, sics, phacoemulsification, schirmer's test

INTRODUCTION

The tear film is 3-layered "sandwich" composed of distinct lipid, aqueous and mucin layers. Mean tear film osmolarity values normal range is 270-315 mOsm/l. Mean tear ph values

ranges between 6.8-8.2. Tear surface tension is 43.6 mN/m and the viscosity at rest of human tears is approximately 9cP[2].

Dry eye illness is estimated to affect 7.4% to 33.7 percent of people[3,4]. Prolonged use of antibiotic-steroid eye drops, decreased tear film break-up time due to surface irregularity at the site of the incision, decreased mucin production from the conjunctiva secondary to incision placement, decreased corneal sensation due to surgical incision which disrupts the cornea-lacrimal gland loop leading to reduced tear secretion, poor tear film production, and stabilities are all factors that contribute to the development of dry eye after cataract surgery[5-7]. Although the symptoms of dry eye are only transient, they have an impact on the patient's quality of life.

SICS, like other limbal relaxing incisions, causes local injury by severing the circumcorneal network of nerve fibres, resulting in corneal hyposensitivity and a reduction in reflex secretion and wound healing. This, combined with prolonged intraoperative duration and exposure to the microscope, has the potential to exacerbate the symptoms.

Phacoemulsification is a contemporary cataract surgery in which the eye's internal lens is emulsified and aspirated from the eye using an ultrasonic handpiece.

Incisional denervation of the corneal nerves, ultrasound-induced free radical production, microscope light exposure time during surgery, and pre- and post-operative medicines have all been linked to dry eye after phacoemulsification.

The ocular surface disease index OSDI, Schirmer's tear test, and Tear break up time are the most commonly used tests for the diagnosis of dry eyes (TBUT).

The OSDI is a subjective questionnaire, whereas the TBUT and Schirmer's test are objective dry eye tests.

Conjunctival cell abnormalities is diagnosed via impression cytology.

Dry eyes is a known after effect of cataract surgery. This study has been designed to evaluate the association and comparison of ocular surface changes and tear film abnormalities (dry eyes) in patients undergoing cataract surgery i.e. Small Incision Cataract Surgery and phacoemulsification. The present study conducted with aim to evaluate the ocular surface and tear film changes following cataract surgery- Small Incision Cataract Surgery (SICS) V/S Phacoemulsification surgery.

MATERIALS AND METHODS

Type of Study: Randomized control trial

Period of Study: March 2022 to March 2023

Place of Study: Present study was conducted in Department of Ophthalmology, Mahatma Gandhi Medical College & Hospital, Jaipur

Ethical approval was obtained from institutional research ethics committee before the start of study

Number of patients: A total of 100 patients attending OPD diagnosed with cataract who underwent surgery; age group of more than 40 years were randomly divided into 2 groups:

Group 1 included all cases who underwent SICS:

a) preoperative

b) postoperative

Group 2 included all cases who underwent PHACOEMULSIFICATION:

a) preoperative
b) postoperative

Written and informed consent was taken from all participants prior to enrolment into the study.

- **Inclusion Criteria**
  1) All cataract cases who underwent surgery in ophthalmology department MGUMST
  2) Age more than 40 years
- **Exclusion Criteria**
  1) Pre-existing ocular Surface Disease
  2) Patients already diagnosed with dry eyes
  3) Patient with any other ocular disorder- pterygium, glaucoma, uveitis, disorders of the lids, disorders of nasolacrimal pathways, ocular allergies.
  4) Contact lens wearers
  5) Previous Ocular Surgery
  6) Patients with systemic diseases- Diabetes, hypertension, autoimmune disorders or on chronic medications
  7) Patients who did not give the consent for study

Diagnosis of Dry Eyes was done by conducting following tests:

- Schirmer's test
- Ocular surface disease index (OSDI)
- Tear film break up time (TBUT)
- Impression cytology (IC)

Statistical Analysis

The data generated was subjected to appropriate statistical analysis. To represent the data; tables and bar diagrams were used. Descriptive statistics in terms of percentage (%) was used to describe the categorical variables. Mean and standard deviation was used to describe various characteristics related to continuous variables.

RESULTS

Table 1: Baseline characteristics of the study groups

Variables	SICS (Group 1)		PHACO (Group 2)		p value
	N=50	%	N=50	%	
Gender					
Male	27	54	29	58	0.69
Female	23	46	21	42	
Age Group (in years)					
44-50	7	14	7	14	0.74
51-60	12	24	11	22	
61-70	20	40	22	44	
>70	11	22	10	20	

Eye					
Left Eye	28	56	29	58	
Right Eye	22	44	21	42	0.84

The present randomised control trial was conducted in Department of Ophthalmology Mahatma Gandhi Medical College & Hospital, Jaipur among 100 patients attending Opd diagnosed with cataract who underwent surgery having age group of more than 40 years were randomly divided into 2 groups i.e. Group 1 (underwent SICS) and Group 2 (underwent Phacoemulsification).

In our study, males were slightly more as compared to females in both the study groups. Maximum subjects were from the age group of 61-70 years (40% and 44% in group 1 and 2 respectively) followed by 51-60 years while minimum subjects were from the age of 44-50 years. Left and right eye involvement was found among 56%, 44% and 58%, 42% of the subjects in group 1 and 2 respectively. When baseline characteristics viz. gender, age and eye involvement was compared among group 1 and 2, it was found to be statistically insignificant as $p>0.05$ (table 1, graph 1).

Graph 1: Baseline characteristics of the study groups

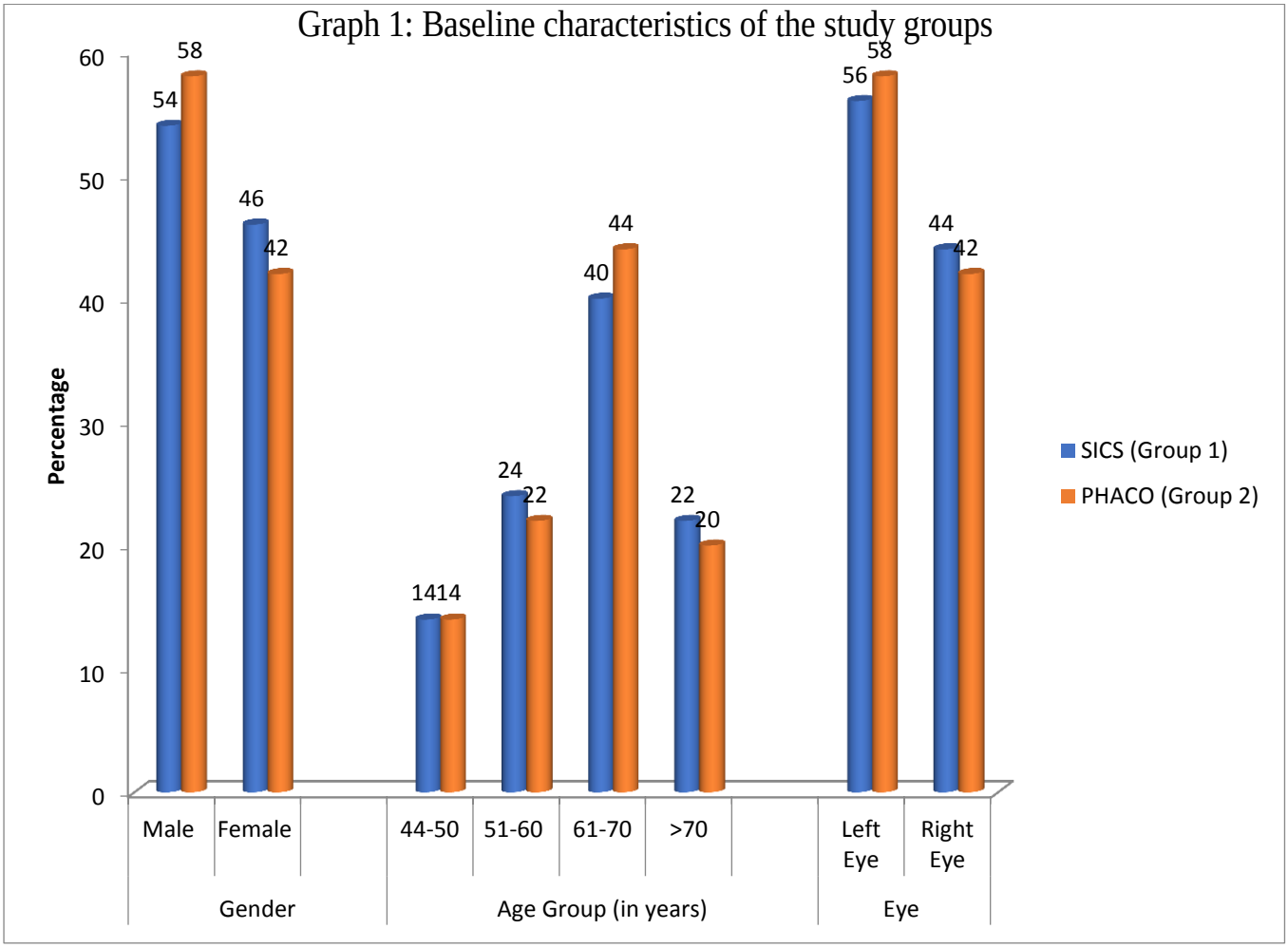

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Table 2: Schirmer's Test at different intervals among the study group

Surgery		Schirmer's Test				p value		
		Pre Operative	1 Week	1 Month	3 Month	Pre Op. vs 1 Week	PreOp vs 1 Month	Pre Op vs 3 Month
Group 1	Mean	21.74	15.18	17.10	19.16	<0.01*	0.002*	0.007*
	SD	4.754	4.188	4.320	4.613			
Group 2	Mean	22.26	18.10	19.76	20.56	0.004*	0.03*	0.044*
	SD	4.184	4.022	4.173	4.156			
t test		0.34	12.65	9.81	2.54			
p value		0.56	0.001*	0.002*	0.11			

*: statistically significant

Table 2, graph 2 shows the comparison of Schirmer's test value at different intervals among the study groups. At baseline, mean Schirmer's test value was 21.74 and 22.26 in group 1 and 2 respectively. After the operation, mean Schirmer's test value reduced more in group 1 as compared to group 2 at 1 week ,1 month and 3 month with statistically significant difference ($p<0.05$). Though both the groups showed improvement at 3 months, but it never reached the baseline value. When mean Schirmer's test value was compared between group 1 and 2, it was found to be statistically significant at 1 week and 1 month of surgery ($p<0.05$) , but it was not significant at 3 month.

Graph 2: Schirmers test at different intervals among the study group

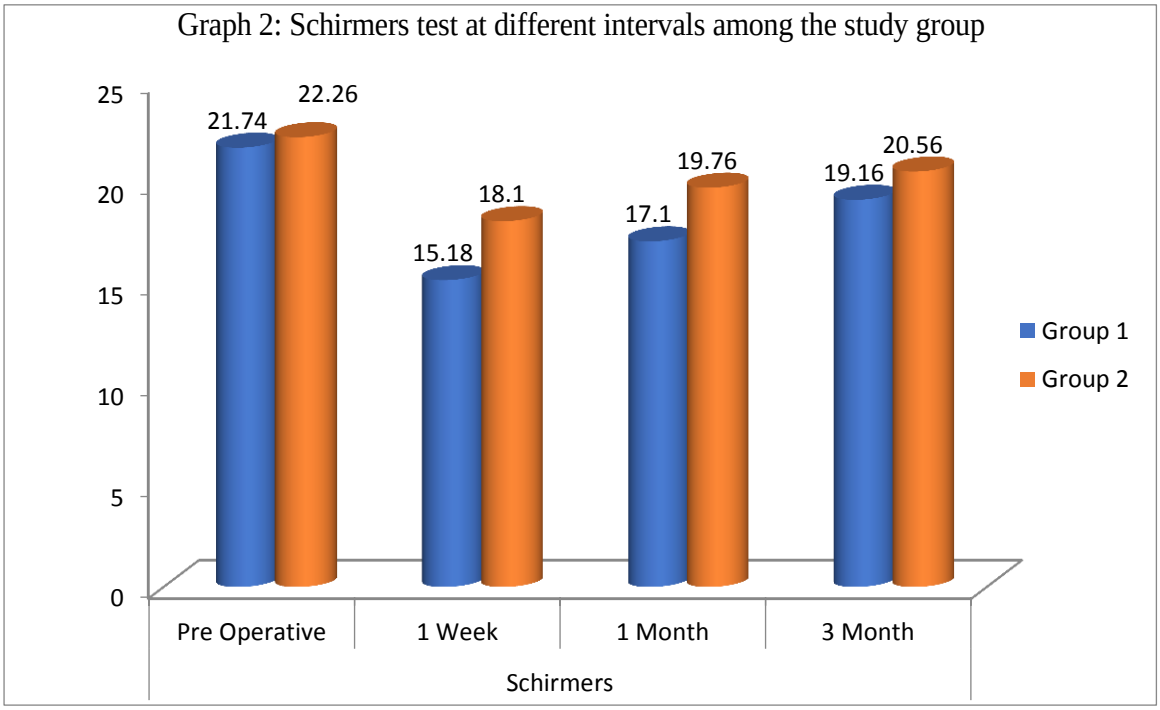

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Table 3: TEAR FILM BREAK UP TIME(TBUT) at different intervals among the study group

Surgery		TBUT				p value		
		Pre Operative	1 Week	1 Month	3 Month	Pre Op. vs 1 Week	PreOp vs 1 Month	Pre Op vs 3 Month
Group 1	Mean	12.36	8.08	9.52	10.64	<0.01*	<0.01*	0.005*
	SD	1.306	1.536	1.129	1.55			
Group 2	Mean	12.52	9.80	10.54	11.24	<0.01*	0.009*	0.041*
	SD	1.488	1.525	1.501	1.83			
t test		0.33	31.56	14.74	2.43			
p value		0.57	<0.01*	<0.01*	0.18			

*: statistically significant

Table 3, graph 3 shows the comparison of TBUT test at different intervals among the study groups. At baseline, mean TBUT value was 12.36 and 12.52 in group 1 and 2 respectively. After the operation, mean TBUT value reduced more in group 1 as compared to group 2 at 1 week, 1 month and 3 month with statistically significant difference ($p<0.05$). Though both the groups showed improvement at 3 months, but it never reached the baseline value. When mean TBUT value was compared between group 1 and 2, it was found to be statistically significant at 1 week and 1 month of surgery ($p<0.05$) , but it was not significant at 3 month.

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Graph 3: Tear film Break Up Time at different intervals among the study group

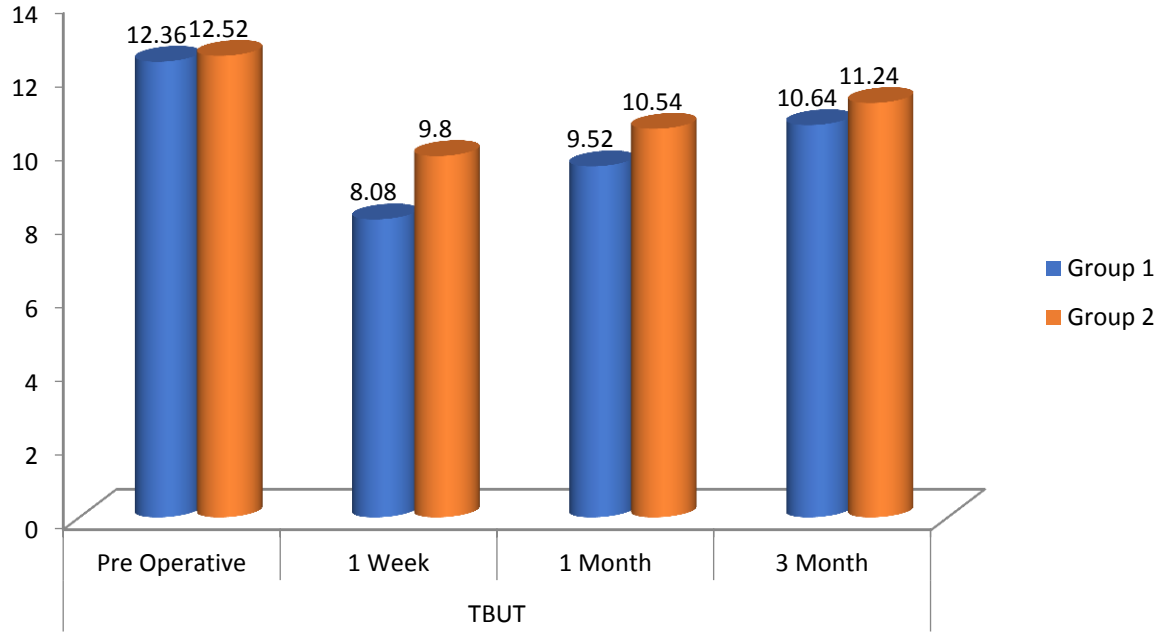


Table 4: OCULAR SURFACE DISEASE INDEX at different intervals among the study group

Surgery		OSDI				p value		
		Pre Operative	1 Week	1 Month	3 Month	Pre Op. vs 1 Week	PreOp vs 1 Month	Pre Op vs 3 Month
Group 1	Mean	10.92	24.58	20.10	16.52	<0.01*	<0.01*	<0.01*
	SD	3.306	3.468	2.643	2.100			
Group 2	Mean	11.12	23.00	19.82	16.44	<0.01*	<0.01*	<0.01*
	SD	4.124	3.550	2.153	2.055			
t test		0.07	3.09	2.96	1.09			
p value		0.79	0.042*	0.047*	0.78			

*: statistically significant

Table 4, graph 4 shows the comparison of OSDI test value at different intervals among the study groups. At baseline, mean OSDI value was 10.92 and 11.12 in group 1 and 2 respectively. After the operation, mean OSDI value increased more in group 1 as compared to group 2 at 1 week and 1 month. Post-operatively three-month, mean OSDI value was approximately same in both group 1 as well as group 2. Significant deterioration in OSDI value was found in both group 1 as well as group 2 after 1 week, 1 month and 3 months of

surgery with statistically significant difference ($p<0.05$). Though both the groups showed improvement at 3 months, but it never reached the baseline value. When mean OSDI value was compared between group 1 and 2, it was found to be statistically significant at 1 week and 1 month of surgery ($p<0.05$) , but it was not significant at 3 month.

Graph 4: Ocular Surface Disease Index at different intervals among the study group

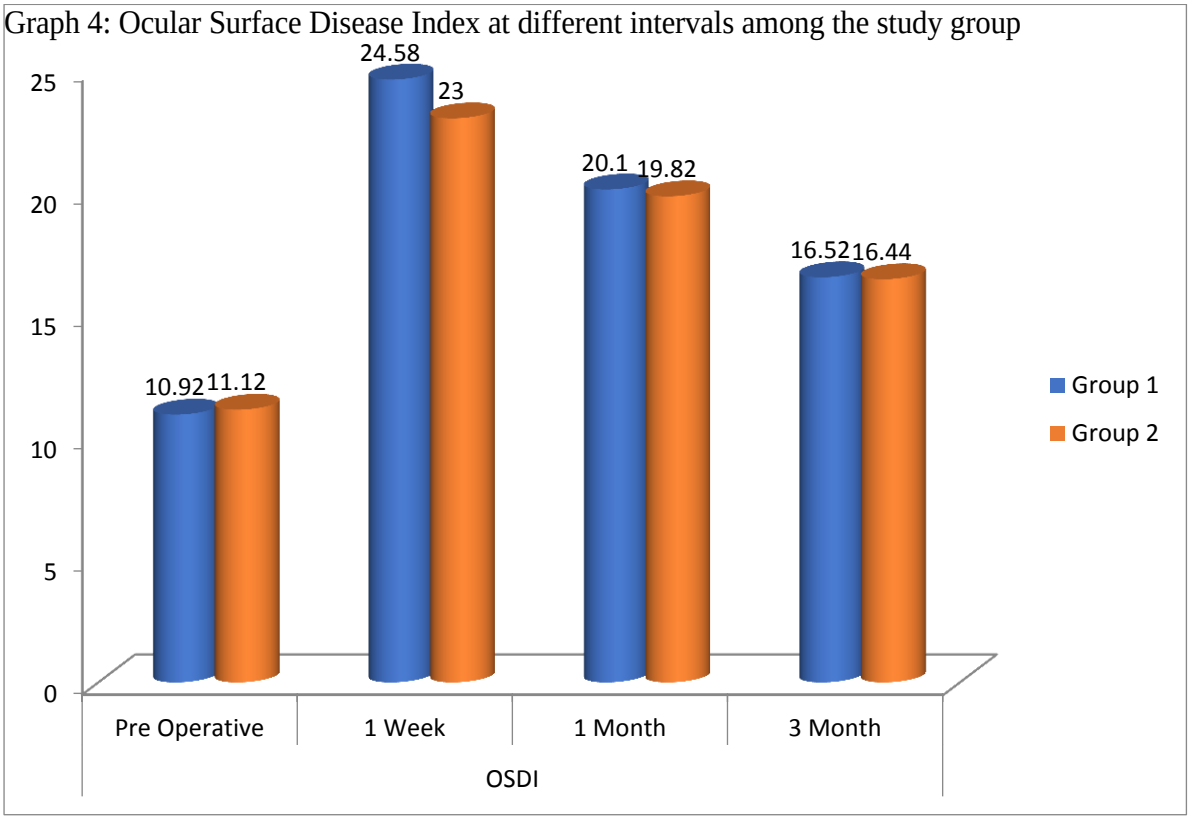


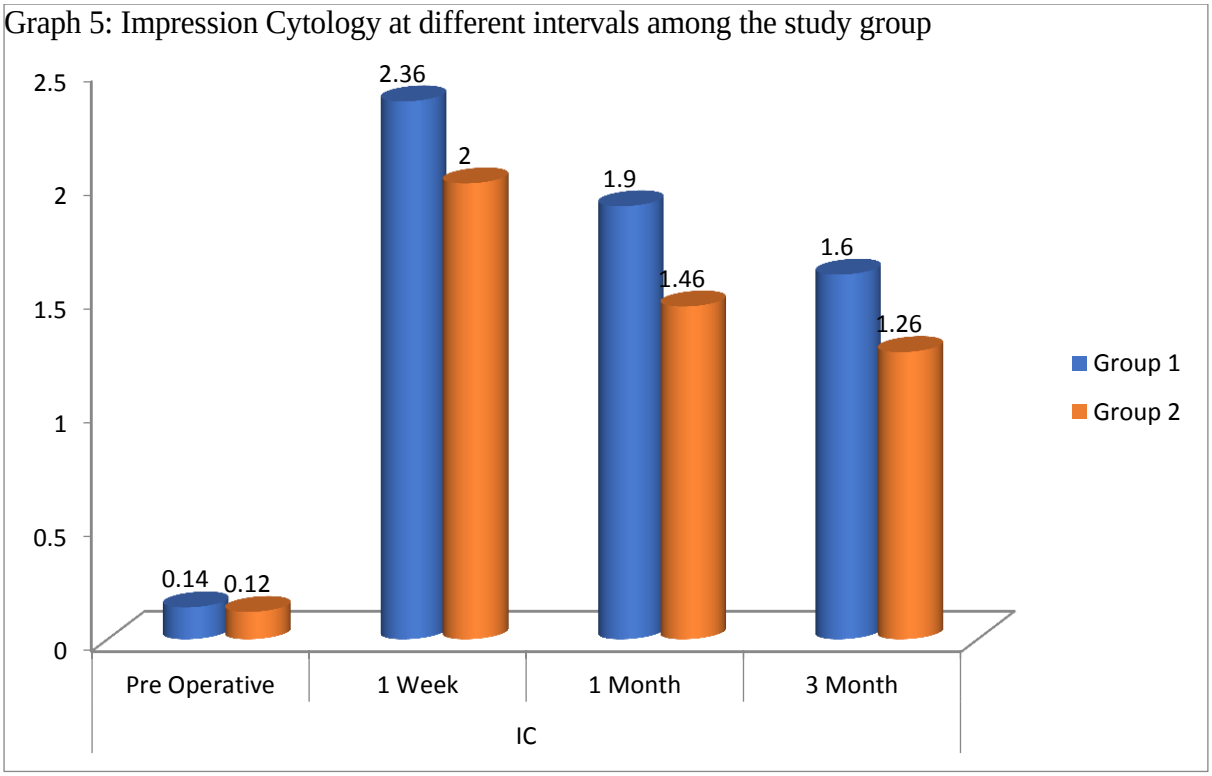
Table 5: Impression Cytology at different intervals among the study group

Surgery		Impression Cytology				p value		
		Pre Operative	1 Week	1 Month	3 Month	Pre Op. vs 1 Week	PreOp vs 1 Month	Pre Op vs 3 Month
Group 1	Mean	0.14	2.36	1.90	1.60	<0.01*	<0.01*	<0.01*
	SD	0.351	0.898	0.763	0.670			
Group 2	Mean	0.12	2.00	1.46	1.26	<0.01*	<0.01*	<0.01*
	SD	0.328	0.756	0.706	0.664			
t test		0.09	4.70	8.96	6.49			
p value		0.77	0.03*	0.003*	0.012*			

*: statistically significant

Table 5, graph 5 shows the comparison of Impression Cytology at different intervals among the study groups. At baseline, mean Impression Cytology value was 0.14 and 0.12 in group 1 and 2 respectively. After the operation, mean Impression Cytology value increased more in group 1 as compared to group 2 at 1 week and 1 month. Post-operatively three-month, mean Impression Cytology value was approximately same in both group 1 as well as group 2. Increase in Impression cytology value (dry eyes) was found in both group 1 as well as group 2 after 1 week, 1 month and 3 months of surgery with statistically significant difference ($p<0.05$). When mean Impression Cytology value was compared between group 1 and 2 after 1 week, 1 month and 3 month of surgery, it was found to be statistically significant ($p<0.05$).

Graph 5: Impression Cytology at different intervals among the study group



DISCUSSION

Dry eye syndrome is a multifactorial pre-corneal tear film condition that causes ocular discomfort, tear film instability and visual disturbance as well as potential ocular surface injury[1]. Prolonged use of antibiotic-steroid eye drops, decreased tear film break-up time due to surface irregularity at the site of the incision, decreased mucin production from the conjunctiva secondary to incision placement, decreased corneal sensation due to surgical incision which disrupts the corneo-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 are the contributing factors leading to dry eyes post cataract surgery[7]. Although the symptoms of dry eye are only transient, they have an impact on the patient's quality of life. As a result, thorough counselling about the ephemeral nature of the illness is required.

The present randomised control trial was conducted in Department of Ophthalmology Mahatma Gandhi Medical College & Hospital, Jaipur among 100 patients attending OPD diagnosed with cataract who underwent surgery having age group of more than 40 years were randomly divided into 2 groups i.e. Group 1 (underwent SICS) and Group 2 (underwent Phacoemulsification).

Baseline Characteristics

In our study, males were slightly more as compared to females in both the study groups. Maximum subjects were from the age group of 61-70 years (40% and 44% in group 1 and 2 respectively) followed by 51-60 years while minimum subjects were from the age of 44-50 years. Left and right eye involvement was found among 56%, 44% and 58%, 42% of the subjects in group 1 and 2 respectively. When baseline characteristics viz. gender, age and eye involvement was compared among group 1 and 2, it was found to be statistically insignificant ($p>0.05$).

Saba Ishrat et al[8] in their study too found that baseline characteristics were comparable among the study groups.

In a study by Pragati Garg et al[9], the largest age group was 61-70 years (n=43, 35.83%), followed by those aged 51-60 years. The male to female ratio was 1.55:1.

SCHIRMER'S TEST

Preoperatively, mean Schirmer's test value was 21.74 and 22.26 in patients who underwent SICS (group 1) and Phacoemulsification surgery (group 2) respectively. After the operation, mean Schirmer's test value reduced more in group 1 as compared to group 2 at 1 week, 1 month and 3 months of surgery with statistically significant difference ($p<0.05$). Though both the groups showed improvement, but it never reached the baseline value. When mean Schirmer's test value was compared between group 1 and 2, it was found to be statistically significant at 1 week and 1 month of surgery ($p<0.05$).

Schirmer's test-1 values improved at 1 and 3 months postoperatively, although they remained lower than the baseline in a study by Oh et al[10]. Reduced postoperative ST-1 scores after phacoemulsification was seen in other studies as well.

Similarly, Saba Ishrat et al[8] in their study found that the ST-1 performed fairly well in both groups, at one week: 19.1 ± 0.89 mm and 20.7 ± 0.81 mm in the SICS and phacoemulsification groups, respectively. But, a decrease in the ST-1 scores was found in early postoperative period at one week in all patients when compared to the preoperative findings.

In a similar study, Saurabh Shrivastava et al[11] discovered a significant difference in preoperative Schirmer's test values compared to day 7 and day 21 postoperative values ($P<0.05$) in groups A and B. Day 90 postoperative levels, on the other hand, were comparable to preoperative values, with no significant difference ($P>0.05$).

TEAR FILM BREAK UP TIME

Preoperatively, mean TBUT value was 12.36 and 12.52 in patients who underwent SICS (group 1) and Phacoemulsification surgery (group 2) respectively. After the operation, mean TBUT value reduced more in group 1 as compared to group 2 at 1 week, 1 month and 3 months of surgery with statistically significant difference ($p<0.05$). Though both the groups showed improvement, but it never reached the baseline value. When mean TBUT value was compared between group 1 and 2, it was found to be statistically significant at 1 week and 1 month of surgery (<0.05).

Cho and Kim[12]found that following cataract surgery, dry eye symptoms and diagnostic test findings worsened compared to preoperative measurements. They came to a conclusion that TBUT and the corneal epithelium's barrier function are impaired in the early postoperative period following cataract surgery which is consistent with the present study.

In their investigation, Saba Ishrat et al[8] discovered significant changes in TBUT levels at 1 week, 1 month, and 3 months postoperatively. The SICS group had a mean TBUT of 10.0±0.55 sec, whereas the phacoemulsification group had a mean TBUT of 13.9 ±0.70 sec ($p<0.001$) at 1 week postoperatively. These findings are similar to our study. When compared to preoperative data, there was a significant decrease in TBUT values in the early postoperative period at one week. Considerable difference was still noticeable at one-month follow-up.

Similarly, Saurabh Shrivastava et al[11] found a significant difference in preoperative tear breakup time (TBUT) values between groups A and B as compared to day 7 and day 21 postoperative values ($P<0.05$) in their study. Day 90 postoperative levels, on the other hand, were comparable to preoperative values, with no significant difference ($P>0.05$).

Oh et al.[9] discovered a significant drop in TBUT in patients, in the early postoperative period; however, the authors noticed that TBUT and ST-1 values improved at 1 and 3 months postoperatively, but remained lower than the baseline. Other studies have found that SICS and Phacoemulsification reduces postoperative TBUT scores.

OCULAR SURFACE DISEASE INDEX

At baseline, mean OSDI value was 10.92 and 11.12 in patients who underwent SICS (group 1) and Phacoemulsification surgery (group 2) respectively. After the operation, mean OSDI value increased more in group 1 as compared to group 2 at 1 week and 1 month. Post-operatively three-month, mean OSDI value was approximately same in both group 1 as well as group 2. Significant deterioration was found in both group 1 as well as group 2 after 1 week, one month and 3 months of surgery with statistically significant difference ($p<0.05$). When mean OSDI value was compared between group 1 and 2 after 1 week and 1 month of surgery, it was found to be statistically significant ($p<0.05$).

According to Saba Ishrat et al[8], at 1 week, 1 month and 3 months postoperative visits, OSDI score kept on decreasing and the symptoms of dry eye showed a trend toward improvement.

IMRESSION CYTOLOGY

At baseline, mean Impression Cytology was 0.14 and 0.12 in patients who underwent SICS (group 1) and Phacoemulsification surgery (group 2) respectively. After the operation, mean Impression Cytology increased more in group 1 as compared to group 2 at 1 week and 1 month. Post-operatively three-month, mean Impression Cytology value was approximately same in both group 1 as well as group 2. Significant deterioration was found in both group 1 as well as group 2 after 1 week, one month and 3 months of surgery with statistically significant difference($p<0.05$). When mean Impression Cytology value was compared between group 1 and 2 after 1 week, 1 month and 3 months of surgery, it was found to be statistically significant ($p<0.05$).

Corneal sensory nerve damage caused by incision is one of the iatrogenic causes of dry eyes after cataract surgery. Corneal denervation can cause decreased tear secretion and reduced blinking. Denervation of a larger portion of the cornea occurs in SICS with a large corneoscleral tunnel incision, which leads to prolonged foreign body sensation with mucus and debris accumulating within the groove. In phacoemulsification cataract surgery, on the other hand, the incision is substantially smaller. As a result, corneal denervation is less as compared to SICS. Hence, we noticed that individuals who underwent SICS had a higher prevalence and severity of dry eyes than those who underwent phacoemulsification surgery. This is in conformity with other studies according to which size of incision corresponded with the severity and duration of dry eyes[102-106]. It is thought that phacoemulsification incisions, at 3 and 9 o'clock i.e., on the richly innervated horizontal areas of cornea leads to reduced tear secretion and hence neurotropic keratopathy. Other authors have also found decreased corneal sensitivity and tear production after cataract surgery.

Limitations:

There are some limitations of this study as with any study.

- Firstly, the corneal sensitivity was not assessed.
- Secondly, a comparison between postoperative dry eye and visual acuity was not done in this study.

CONCLUSION

Incidence of dry eye is higher in Small Incision Cataract Surgery (SICS) than phacoemulsification due to tear film instability. To conclude dry eye is known to have various etiological factors out of which cataract surgery is one of the factors predisposing to dry eye. Eyes with post operative dry eye may also have lesser visual recovery compared to those who do not develop significant dryness. In light of the high incidence of dry eye following cataract surgery, as our study suggests the use of an appropriate lubricating agent atleast for 3 months after cataract surgery in order to avoid dry eye-related complications following surgery and provide symptomatic relief to patients.

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