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# Evaluation of Dry Eye Disease Post-Cataract Surgery using Symptom Questionnaire and Tear Film Tests

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## ABSTRACT

**Purpose:** To study the changes in ocular surface disease index and tear film tests for evaluation of dry eye among patients who have undergone cataract surgery.

**Methods:** A total of 123 patients aged more than 40 years undergoing cataract extraction were included. 87 of them underwent manual Small Incision Cataract Surgery (SICS) and 36 underwent Phacoemulsification (Phaco). Dry eye symptoms were evaluated using OSDI (Ocular Surface Disease Index) questionnaire, tear film assessment was done using Schirmer's test 1, TBUT (Tear Film Break up Time) at baseline and 6 weeks after surgery. Relevant statistical tests were used to evaluate the significance of the variables.

**Results:** The overall incidence of dry eye using OSDI score was 29.26%, with mean OSDI scores of  $13.85 \pm 9.83$  and  $23.12 \pm 14.54$ , pre and post-operative respectively a difference in score of 9.234 and significant P value ( $<0.001$ ). Out of 55 dry eye positive subjects 49 (89.09%) had mild symptoms and 6 (10.9%) had moderate symptoms. Incidence using tear film tests such as Schirmer's test 1 was found to be 12.19% and TBUT was found to be 24.39%. All dry eye test values were significantly impaired at 6 weeks of post cataract extraction.

**Conclusion:** Incidence of dry eye after cataract surgery was 29.26%. Cataract surgery is capable of causing and aggravating dry eye. TBUT and OSDI scores indicated more cases of dry eye postoperatively compared to the Schirmer's test 1 scores. Thus TBUT and symptom scores are better indicators for assessing dry eye.

**Key Words:** Dry eye, Ocular surface disease index, Tear film tests, Cataract surgery

## INTRODUCTION

Dry eye is a multifactorial disorder involving an ocular surface. It leads to significant morbidity due to its symptoms, commonly surface discomfort like foreign body sensation, pricking and gritty feeling, light sensitivity and visual disturbance. Disturbance in the osmolarity of the tear film and increase in the inflammatory mediators have been described as the common causes. Also chronic dry eye can lead to ocular surface damage<sup>1</sup>. Dry eye as a chronic disease has significant impacts on quality of life in elderly population. Several risk factors have been proposed for dry eye syndrome; among them older age, female gender, diabetes and high blood pressure are well-known causes.<sup>2,3</sup> Many patients who have undergone cataract surgery have complaints of dry eye and main cause of dissatisfaction in such cases has been

shown to be fatigue and foreign body sensation due to dry eye syndrome.

The ocular surface disease worsens most often after cataract surgery, multiple factors can contribute including transection of corneal nerves leading to loss of corneal sensations and impaired healing, damage to the corneal epithelium due to intense microscopic light exposure, prolonged irrigation of ocular surface with irrigating solutions, ocular surface irritation leading to an elevation in the inflammatory mediators and use of preservatives in topical anesthetic drops.<sup>4-6</sup>

Most common surgery performed in ophthalmic units being cataract surgery, and since senile cataract comprises most of the cataract surgery, the identification and management of ocular surface disease is therefore imperative.

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## MATERIALS AND METHODS

A prospective observational study conducted at a tertiary center in South India, during the period of August 2019 and January 2020. All patients aged more than 40 years who underwent cataract surgery in the department of ophthalmology were included. Patients on topical or systemic medications known to cause dry eye, contact lens wearers, history of ocular surgery within last 6 months, systemic diseases associated with dry eye such as connective tissue disorders (Sjogren's, rheumatoid arthritis), patients with any ocular disorder known to produce dry eye, acute ocular infections, impaired eyelid function like bell's palsy, lagophthalmos, ectropion were excluded.

An ocular surface disease index(OSDI) questionnaire was given to all patients before subjecting them to examination. OSDI questionnaire is a 12-item questionnaire used worldwide to accurately assess symptoms of ocular irritation related to dry eye and vision.<sup>7</sup>

Its reliability has been proved by literature.<sup>8</sup>The total OSDI score was calculated using the following formula: OSDI score=(sum of all answered questions) x 100/total number of answered questions) x 4. All subjects who were literate and understood the questionnaire were allowed to fill the forms independently, while subjects who are illiterate and whose vision was hampered enough to not being able to fill form independently were helped with translating into their own vernacular or simply read out the questions and responses were filled accordingly.

A detailed history, including demographic data, comprehensive ophthalmologic examination, assessment of best-corrected visual acuity (BCVA), ocular adnexal examination, the grade of cataract and the fundus examination, was done. All surgeries were carried out under local anesthesia by multiple experienced surgeons, SICS with superior scleral incision of 6-7 mm length with implantation of rigid PMMA(Poly Methyl Methacrylate) intra-ocular lens was implanted. Phacoemulsification with 3mm clear corneal supero-temporal incision was done with implantation of a foldable intra-ocular lens. Post-operative standard topical steroid and antibiotic regimen was followed for 3 weeks. Only cases with uneventful surgery were included in the study.OSDI questionnaire and ocular surface tests like Schirmer's 1 and Tearfilm Break Up Time (TBUT) were done pre-operative baseline and repeated after 6 weeks of surgery.

Student t test has been used to find the significance of study parameters on continuous scale and Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale.P value:P = 0.01 to 0.05 was considered moderately significant whereas P value : P=0.01 was considered strongly significant.

## RESULTS

A total of 123 patients were included in the study, 87 patients (70.7%) underwent manual Small Incision Cataract Surgery (SICS) and 36 patients (29.3%) underwent Phacoemulsification (Phaco). Out of 123 patients, 67 patients (54.5%) were found to be Females and 56 patients (45.5%) were males. Demographic and clinical data are summarised in Table 1.

Pre and post-operative mean values of OSDI and tear film test scores are summarized in Table 2. Difference in pre and post-operative mean OSDI score among SICS group was 9.270 and P value of (<0.001) which is strongly significant. Among phaco group the difference between pre and post-operative mean OSDI score was 9.15 and P value of (<0.001) which is strongly significant. Table 3 summarizes the severity of dry eye according to OSDI score.

SICS: 71 (81.6%) patients had no dry eye symptoms preoperatively. 16 patients (18.4%) had positive symptoms before surgery. Post-operatively total 40 patients had positive score, and 35 had mild symptom scores between 26-50 and 5 patients with moderate symptom scores of 51-75.

It was observed that total of 24 out of 71 normal subjects were newly diagnosed dry eye positive following surgery with an incidence of 27.58%

Phacoemulsification: out of 36 patients who underwent phacoemulsification 33 patients (91.7%) had normal scores pre-operatively. And 3 patients had positive symptom scores, 2 of them had mild and one patient had moderate symptom score respectively. Post-operatively, 15 patients were observed to have dry eye-positive scores; 14 had mild symptom scores of 26-50 and one patient had moderate symptom scores of 51-75. It was observed that 12 out of 33 normal subjects were newly diagnosed dry eye positive following surgery with an incidence of 33.33%. Overall incidence was found to be 29.26%.

Schirmer's test 1 results: Among SICS group mean decrease in the Schirmer's test 1 score post-operatively was 4.01mm and P value of <0.001 which is strongly significant. Overall 16 patients were positive for dry eye post-operatively, among them 10 had mild, 5 had moderate and 1 patient had severe decrease in Schirmer's test 1 scores. It was observed that total of 12 patients among 83 normal subjects were newly detected dry eye positive post-operatively according to Schirmer's test 1 score, with an incidence of 13.79%. Among phacogroup mean decrease in Schirmer's test 1 results score post-operatively was found to be 3.19mm and P value of <0.001 which is strongly significant. Post-operative total of 5 patients were dry eye positive with 3 patients having mild and 2 patients having moderate Schirmer's test 1 scores. It was observed that total of 3 patients among 34 normal subjects developed dry eye following surgery with an incidence of 8.33%. An overall incidence of Schirmer's test 1 positive

for dry eye post-operatively was found to be 12.19%. severity grading is summarized in Table 4

TBUT test results: Among SICS patients mean decrease in TBUT scores post-operatively was found to be 2.59sec and a P-value of <0.001 which was strongly significant. Post-operatively a total of 82 patients had positive dry eye scores, with 24 of them having severe dry eye scores less than 5sec. It was observed that out of 26 normal subjects 21 patients were newly detected TBUT test positive for dry eye following surgery with incidence of 24.13% . Among phaco group mean decrease in TBUT score was found to be 2.639sec, with P-value of <0.001 which was strongly significant. Post-operatively total of 36 patients were positive for dry eye, 6 among them had scores less than 5sec. It was observed that out of 11 normal subjects 9 patients were newly detected TBUT test positive for dry eye following surgery with incidence of 25%. An overall incidence of TBUT test positive for dry eye post-operatively was found to be 24.39%. Severity grading is summarized in table 4.

## DISCUSSION

Dry eye produces tear film instability resulting in discomfort and reduced vision. Chronic unstable ocular surface leads to break up in the tear film with further exposure of the corneal and conjunctival epithelium to evaporation which leads to increased inflammation and thus a vicious cycle.<sup>9</sup>

The present study evaluated the impact between tear film parameters and patient's symptoms. Hence this study shows patients who experience ocular surface symptoms after surgery have an eventual increase in their discomfort to pre-operative values.

There is no single gold standard investigation for the assessment of dry eye. Hence multiple diagnostic methods are used with variable sensitivity and specificity. Ocular surface questionnaires are often used in research studies involving dry eye assessment in various conditions.<sup>10,11</sup> We have used OSDI questionnaire in our study, it has sensitivity of 60% and specificity of 79% as per the literature.<sup>6</sup> We modified the OSDI questionnaire by omitting ocular symptom evaluation questions pertaining to vision, and hence we can avoid bias due to better visual acuity post-operatively. Similar modifications have been done in previous studies.<sup>12</sup>

A study done by Sitomptu et al., revealed that OSDI score reduced after 2 weeks of SICS surgery, however overall OSDI improved significantly after phacoemulsification surgery in the follow-up visits.<sup>13</sup>

They also found out that OSDI scores steadily decrease in the follow up period upto 3 months although some of the dry eye tests like TMH (Tear Meniscus Height), Schirmer's test improved after 1 month period.

In our study though overall incidence of dry eye at post-operative 6week was found to be 29.26% using OSDI score, overall incidence by using tear film test, i.e, Schirmer's test 1 was found to be 12.82%. This indicates that the patients continued to have symptoms of dry eye although their tear functions improved.

All patients showed an increase in OSDI score at post-operative 6weeks duration with significant P values(0.001) in both groups. The overall prevalence of dry eye post-operative 6week was found to be 44.71%. Among them 35 (40.2%) had mild and 5 (5.7%) had moderate dry eye among SICS group. In phaco group 14 (38.9%) had mild and 1 (2.8%) had moderate dry eye scores. However none of them had severe dry eye. Among patients who were pre-operatively diagnosed as dry eye positive, all patients showed an increase in the OSDI scores, suggesting worsening of dry eye post-operatively.

Prior studies have examined the effect of cataract surgery on tear film parameters and reported short-term disruption in tear function. Ram et al, in 23 post-cataract surgery patients demonstrated decrease in Schirmer's score and TBUT.<sup>14</sup> Also study done by Kasetsuwan et al showed TBUT and oxford schema of the questionnaire indicated more cases of post-operative dry eye, however not so with Schirmer's test 1 without anaesthesia.<sup>12</sup>

In the present study the overall incidence of dry eye using TBUT was 24.39% . However, overall incidence of dry eye using Schirmer's test 1 was found to be 12.82%.

Our study also shows the incidence of dry eye was found to be more among Phaco group, however, the severity of reduction in dry eye test values were found more in SICS group. The explanation could be because, compared to wound size in phaco, which is usually 3-4mm, the size of the SICS would be 6-7 mm, with more corneal nerve transects causing more decrease in test values.<sup>13,15</sup>

A new criteria by ADES/JDES(Asia Dry Eye Society/ Japan Dry Eye Society) suggests that patients who present with dry eye symptoms and have decreased TBUT of <5 seconds were considered to have Dry Eye Disease (DED); however Schirmer's test and epithelial damage were not considered as criteria for diagnosis.<sup>16</sup>

In our study also dry eye symptoms and TBUT scores correlate better than schirmer's test suggesting Schirmer's test is not a better indicator of dry eye. The reason why TBUT and OSDI scores indicate more cases of post-operative dry eye compared to the Schirmer's test 1 is because these tests can easily detect tear film instability and ocular surface inflammation respectively, as TBUT detects abnormalities of tear film due to evaporative component secondary to lipid deficiency indicating tear film instability, while OSDI questionnaire is formulated based on the symptoms which are

related to surface inflammation.<sup>7,12,17</sup> A main cause of dissatisfaction following an uneventful cataract extraction and with good post-op vision is eye fatigue and foreign body sensation due to dry eye syndrome.<sup>18</sup> Our study observed that cataract surgery is capable of affecting dry eye test values thereby causing and aggravating dry eye. Therefore need for pre-operative evaluation for dry eye and counseling of each patient is imperative.

In our study all the dry eye tests showed deterioration following cataract surgery, and also increase in symptom following surgery. Since our study involved only one post-operative visit at 6 weeks duration, evaluation of pattern of improvement in dry eye test values and symptom severity could not be done. Also evaluation of corneal sensitivity, intra-operative duration and intensity of light exposure by operating microscope were not considered. Hence further studies where evaluation of dry eye symptom score along with tear film tests and corneal sensitivity can be done to evaluate the recovery pattern of corneal sensations and also duration of corneal nerve regeneration.

## CONCLUSION

In our study we conclude that evaluating the dry eye symptom score is important while treating the post-operative dissatisfied patient with ocular surface symptoms, rather than considering dry eye test values alone. It is imperative to counsel each and every patient in terms of post-operative worsening of dry eye symptoms.

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**Table 1: Table showing demographic and clinical data of the patients.**

1. Mean age	63.47±9.85years (41-85years)
2. Gender	
Male	N= 67 (54.5%)
Female	N=56 (45.5%)
3. Grade of cataract	
NS <sub>1</sub>	N = 9 (7.3%)
NS <sub>2</sub>	N = 43 (35.0%)
NS <sub>3</sub>	N = 28 (22.8%)
NS <sub>4</sub>	N = 13 (10.6%)
SMC	N = 30 (24.4%)
4. Type of surgery	
SICS	N = 87 (70.7%)
PHACO	N = 36 (29.3%)

NS- Nuclear Sclerosis, SMC- Senile Mature Cataract, SICS- Small Incision Cataract Surgery, PHACO- Phacoemulsification

**Table 2: Table showing pre and post-operative mean values of OSDI and tear film test scores**

		OSDI	SCHIRMER'S I	TBUT (In Seconds)
SICS	PRE	13.85± 9.83	23.86± 3.84	9.68± 2.19
	POST	23.12± 14.54	19.85± 5.23	7.08± 2.62
	P VALUE	<0.001	<0.001	<0.001
PHACO	PRE	13.08± 11.11	23.42± 3.38	9.89± 1.33
	POST	22.24± 12.36	20.22± 4.43	7.25± 1.93
	P VALUE	<0.001	<0.001	<0.001
TOTAL	PRE	13.85± 9.83	23.86± 3.84	9.68± 2.19
	POST	23.12± 14.54	19.85± 5.23	7.08± 2.62

OSDI- Ocular Surface Disease index, TBUT- Tear Film Breakup Time, SICS- Small Incision Cataract Surgery, PHACO- Phacoemulsification

**Table 3: Table showing severity of dry eye according to OSDI score in both groups.**

OSDI	Pre	Post	% change	P value
SICS (n=87)				
<25	71(81.6%)	47(54%)	-27.6%	<0.001**
25-50	16(18.4%)	35(40.2%)	21.8%	
51-75	0(0%)	5(5.7%)	5.7%	
76-100	0(0%)	0(0%)	0.0%	
Phaco (n=36)				
<25	33(91.7%)	21(58.3%)	-33.4%	0.001**
25-50	2(5.6%)	14(38.9%)	33.3%	
51-75	1(2.8%)	1(2.8%)	0.0%	
76-100	0(0%)	0(0%)	0.0%	

OSDI- Ocular Surface Disease index, SICS- Small Incision Cataract Surgery, PHACO- Phacoemulsification

**Table 4: Table showing different grades of severity according to schirmer's test 1 and TBUT scores in both groups.**

		Grade	Pre	Post	% change
Schirmers-1(mm)	SICS (n=87)	1-5	0(0%)	1(1.1%)	1.10%
		6-10	1(1.1%)	5(5.7%)	4.60%
		11-15	3(3.4%)	10(11.5%)	8.10%
		>15	83(95.4%)	71(81.6%)	-13.80%
	Phaco (n=36)	1-5	0(0%)	0(0%)	0.00%
		6-10	0(0%)	2(5.6%)	5.60%
		11-15	2(5.6%)	3(8.3%)	2.70%
		>15	34(94.4%)	31(86.1%)	-8.30%
TBUT(sec)	SICS (n=87)	1-5	4(4.6%)	24(27.6%)	23.00%
		6-10	57(65.5%)	58(66.7%)	1.20%
		11-15	26(29.9%)	5(5.7%)	-24.20%
		1-5	0(0%)	6(16.7%)	16.40%
	Phaco (n=36)	6-10	25(69.4%)	30(83.3%)	13.90%
		11-15	11(30.6%)	0(0%)	-30.60%

SICS- Small Incision Cataract Surgery, PHACO- Phacoemulsification, TBUT- Tear Film Breakup Time