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Effect on tear film after SICS and Phacoemulsification: A comparative study

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Abstract
Aim: To study and compare the tear function parameters (TBUT, Schirmer test -1) and clinical manifestations of dry eye with the help OSDI (ocular surface disease index) score preoperatively and postoperatively in patients of small incision cataract surgery (SICS) and phacoemulsification.
Material and methods: The present randomized prospective study was conducted on 100 patients from August 2017-July 2019 attending outpatient Department of Ophthalmology of Chhatarpati Shivaji Subharti Hospital, Meerut. Patients were divided in two groups of 50 each i.e. Group A (who underwent SICS) and group B (who underwent Phacoemulsification). Complete ocular examination was done which included questionnaire using OSDI score and slit lamp bio microscope examination, tear film breakup time and schirmer test-1.Data analysis was done using SPSS software.
Results: All the dry eye tests conducted on the eyes undergoing cataract surgery showed deterioration following cataract surgery. Both SICS and Phacoemulsification cause significant decrease in TBUT,ST-1 and OSDI score values at post-op 1week,4th week and 8th week.
Conclusion: Both SICS and Phaco surgery can cause or aggravate dry eye and affect the dry eye test values in postoperative period up to 2 months.

Keywords: small incision cataract surgery, phacoemulsification, schirmer test-1, tear breakup time, ocular surface disease index score

Introduction
A smooth ocular surface and tear film are essential for the formation of clear image as they constitute first refractive medium. Dry eye disease is an ocular surface disorder which produces ocular discomfort and influences quality of life. It is defined [1] as "a disorder of the tear film due to tear deficiency or excessive tear evaporation which causes damage to inter-palpebral ocular surface and is associated with symptoms of ocular discomfort." The symptoms of dry eye are itching, sandy-gritty sensations, tiredness, pain, redness, pressure and photophobia. Cataract surgery is known to alter tear film and ocular surface both qualitatively and quantitatively. Convectional cataract surgery by virtue of its large incision is known to denervate cornea producing corneal desensitization and break in lacrimal function unit. The sensory denervation interferes with the normal physiology of the corneal epithelium and decrease in epithelial cell mitosis, delaying wound healing [2, 4].
Studies [5, 6] have highlighted a temporary or even permanent derangement of tear function and ocular surface following both manual Sics and Phacoemulsification procedures. Comparative studies for these procedures, evaluating tear function and ocular surface integrity using acceptable functional indices are lacking. Our present observational study was designed to evaluate the effect on tear film, following both these common surgical procedures and ascertain the superiority of one against the other.

Aim and Objectives
To study and compare the tear function parameters (TBUT, Schirmer test -1) and clinical manifestations of dry eye with the help OSDI (ocular surface disease index) Score preoperatively and postoperatively in patients of small incision cataract surgery (SICS) and phacoemulsification.

Material and Methods
This was a prospective randomized observational cohort study planned for patients undergoing surgery for age related senile cataract at Chhartarpati Shivaji Subharti Hospital, Meerut. Prior clearance for the study was taken from institutional ethics committee and an informed consent was taken from all participants of the study. All cases underwent a detailed preoperative evaluation including vision, refraction, anterior segment and posterior segment evaluation. The subjects were selected according to the following inclusion and exclusion criteria:

Inclusion criteria
Patients having age >40 years and unilateral or bilateral age related cataract.

Exclusion criteria
Age <40 years, cataract caused by an etiology other than age eg. trauma, uveitis, drug induced, pre-existing ocular diseases glaucoma, disorders of lids, conjunctiva, cornea and sclera, chemical burns, radiation, use of contact lens, patients on chronic ocular medications, patients who have undergone corneal refractive surgery, patients who have ocular allergies, pterygia or blepharitis were excluded from the study.
Patients above 40 years were included in the study and age matched randomization was done in 2 groups of 50 each, on the mode of surgery undertaken, SICS or

phacoemulsification.

Group A: 50 patients scheduled for SICS with PCIOL implantation

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

Procedure: A detailed history was taken from all the cases. After taking detailed history, subjects underwent following examination:

1. Visual acuity and best corrected visual acuity in each case was determined using Snellen chart.
2. Examination of anterior chamber segment was done on the slit lamp to rule out any corneal pathology.
3. Dry eye parameters TBUT, Schirmer's Test-1 and OSDI score were evaluated.
4. All patients underwent complete ophthalmic examination followed by measurement of dry eye parameters preoperatively and postoperatively at day 1,1st week, 4th week and 8th week.

Statistical analysis

Statistically analysis was performed on an intent to treat basis using IBM, SPSS statistics version 25(IBM inc.). Students paired T test was done to compare group A and B. Tukey-Post-hockey test was applied in between pre-op and post-op intervals. Chi-square test was applied to measure proportions. P values less than 0.05 was considered statistically significant.

Results

The mean age in group A (SICS) was 62.52±13.41 years while it was 62.16±12.94 years in group B (PHACO). The maximum no of patients fell in the age interval of 61-70 in Group B (PHACO) i.e. 16 (32%) and in age interval 71-80 under group A (SICS) i.e. 15 (30%). The male: female ratio in group A was 1:1 and in group B was 1.

We found that preoperatively, the mean value of schirmer test -1 at different age intervals (41-50, 51-60, 61-70 and 71-80 years) was 21.08, 19.66, 15.85 and 13.33mm respectively under SICS group with statistical significant difference. The preoperative mean value of schirmer test-1 at different age intervals mentioned as above were 21.46, 19.71,15.68 and 13.64mm under Phaco group with statistical significant difference (table 1).

In SICS group, there was significant increase in post-op day 1 value in comparison to preop mean TBUT values except for age group 51-60. On post-op day 7, there was significant decrease in mean TBUT value in comparison to day1 and Preop mean values. On post-op 4th week and 8th week no significant decrease was noticed in mean values in comparison to Pre-op TBUT mean values. In PHACO group, there was significant decrease in mean TBUT values on post-op day 7 in comparison to mean Pre-op values. There was no significant decrease noticed on post-op 4th week and 8th week in comparison to preop values. On applying Anova between preop and various post-op intervals, the overall mean was significant (p value<0.01). When SICS and PHACO values in relation to mean TBUT values were compared with each other at preop, day 1, day 7, 4th week and 8th week, the difference was found to be statistically insignificant as p>0.05 (table 2). Similar results were reported in SICS as well as PHACO group in relation to OSDI values (table 3).

In SICS group, post-op 8thweek, there was slight increase in no of patients having mild dry eyes from 20(40%) to 22(44%) followed by increase in no of patients having moderate dry eyes from (10%) to (14%) and decrease in number of patients who were of normal grade from 25(50%) to 21(42%) with statistically significant difference as p<0.05. In PHACO group, post-op 8th week, there was increase in no of patients having mild grade dry eyes from 21(42%) to 22(44%) followed by increase in patients having moderate dry eyes from 4(8%) to 7(14%) of severe grade and decrease in no of pts of normal dry eye grade from 25(50%) to 21(42%) with statistically significant difference as p<0.05 (table 4).

In SICS group, post-op 8th week, there was increase in number of mild dry eye patients from 26(52%) to 31(62%) followed by moderate dry eye pts from 0(0%) to 6(12%) and decrease in no of pts of normal dry grade from 24(48%) to 13(26%). In PHACO group, post-op8th week, there was increase in no of patients having mild dry eyes from 25(50%) to 26(52%) followed by increase in moderate dry eyes were from 0(0%) to 7(14%) as shown in table 5.

In SICS group, post-op 8th week, maximum no of patients developed moderate dry eyes (n=44, 88%) and there was decrease in number of patients with severe dry eye (n=6, 12%). In PHACO group, post-op 8th week, maximum no of patients developed moderate dry eyes (n=46, 92%), patients who were normal (n=3, 6%) and there was decrease in no of patients with severe dry eye (n=1, 2%).

Table 1: Comparison between SICS and PHACO group in relation to mean TBUT values among different age group during Preop and Post-op intervals

Interval	41-50 years		51-60 years		61-70 years		71-80 years	
	SICS	PHACO	SICS	PHACO	SICS	PHACO	SICS	PHACO
Preop	21.08	21.46	19.66	19.71	15.85	15.68	13.33	13.64
Day1	24.41	23.61	22.44	21.71	18.85	18.18	16.5	15.5
Day7	15.08	15.46	13.66	13.42	9.85	9.93	8.53	8.42
4thweek	17.33	17.76	16.33	16.14	11.92	12.5	10.73	10.64
8thweek	18.5	19.23	17.11	17.42	13.14	13.93	11.66	11.78
p value	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*

*: statistically significant

Table 2: Comparison between SICS and PHACO group in relation to mean TBUT values among different age group during Preop and Post-op intervals

Interval	41-50 years		51-60 years		61-70 years		71-80 years	
	SICS	PHACO	SICS	PHACO	SICS	PHACO	SICS	PHACO
Preop	11.54	11.44	10.86	11.02	9.48	9.33	8.92	8.8
Day1	13.05	12.39	12.03	11.88	10.85	10.6	10.32	9.84
Day7	9.15	8.92	8.66	8.67	6.68	6.84	6.48	6.32

4thweek	10.13	10	9.34	9.47	7.9	7.86	7.6	7.4
8thweek	10.45	10.56	9.84	9.94	8.29	8.31	7.99	7.83
p value	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*

*: statistically significant

Table 3: Comparison between SICS and PHACO group in relation to mean OSDI values among different age group during Preop and Post-op intervals

Interval	41-50 years		51-60 years		61-70 years		71-80 years	
	SICS	PHACO	SICS	PHACO	SICS	PHACO	SICS	PHACO
Preop	60.45	62.38	67.2	65.04	65.52	67.23	62.64	67.75
Day1	66.02	60.61	69.18	69.81	66.79	69.18	67.99	64.25
Day7	50.61	44.9	50.86	49.65	50.72	52.75	54.48	51.36
4thweek	31.07	32	37.72	37.1	38.28	39.25	39.45	39.4
8thweek	18.42	18.49	21.34	19.9	21.22	19.55	24.11	21.38
p value	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*

*: statistically significant

Table 4: Pre and post op Schirmer Test-1 grading in group A (SICS) and B (PHACO)

Group	Pre-op		Day1		1st week		4th week	8th week		
	N	%	N	%	N	%	N	%	N	%
SICS										
Severe (0-5)	0	0	0	0	3	6	1	2	0	0
Moderate (5-10)	5	10	0	0	22	44	12	2	7	14
Mild (10-15)	20	40	10	20	17	34	19	38	22	44
Normal (>15)	25	50	40	80	8	16	18	36	21	42
Chi square	7.81									
p value	0.03*									
PHACO										
Severe (0-5)	0	\	0	0	4	8	0	0	0	0
Moderate (5-10)	4	8	0	0	22	44	12	24	7	14
Mild (10-15)	21	42	10	20	15	30	20	40	22	44
Normal (>15)	25	50	40	80	9	18	18	36	21	42
Chi square	10.59									
p value	0.01*									

*: statistically significant

Table 5: Pre and post op TBUT grading in group A (SICS) and B (PHACO)

Group	Pre-op		Day1		1st week		4th week		8th week	
	N	%	N	%	N	%	N	%	N	%
SICS										
Severe (0-5)	0	0	0	0	4	8	0	0	0	0
Moderate (5-7)	0	0	0	0	17	34	8	16	6	12
Mild (7-10)	26	52	12	24	24	48	32	64	31	62
Normal (>10)	24	48	38	76	5	10	10	10	13	26
Chi square	10.59									
p value	0.01*									
PHACO										
Severe (0-5)	0	0	0	0	2	4	0	0	0	0
Moderate (5-7)	0	0	0	0	19	38	11	22	7	14
Mild (7-10)	25	50	16	32	27	54	29	58	26	52
Normal (>10)	25	50	34	68	2	4	10	20	17	34
Chi square	14.41									
p value	<0.01*									

*: statistically significant

Table 6: Pre and post op OSDI grading in group A (SICS) and B (PHACO)

Group	Pre-op		Day1		1st week		4th week		8th week	
	N	%	N	%	N	%	N	%	N	%
SICS										
Severe (33-100)	50	100	50	100	50	100	31	62	6	12
Moderate (23-32)	0	0	0	0	0	0	19	38	44	88
Mild (13-22)	0	0	0	0	0	0	0	0	0	0
Normal (0-12)	0	0	0	0	0	0	0	0	0	0
Fisher exact test	2.78									
p value	0.04*									
PHACO										

Severe (33-100)	50	100	50	100	48	96	33	66	1	2
Moderate (23-32)	0	0	0	0	2	4	16	32	46	92
Mild (13-22)	0	0	0	0	0	0	0	0	0	0
Normal (0-12)	0	0	0	0	0	0	1	2	3	6
Fisher exact test	2.61									
p value	<0.04*									

*: statistically significant

Discussion

Cataract surgery is most successful and classic surgery, which has good visual acuity to many patients. In our study the minimum age of patient was 42 years and the maximum age was 80 years. The patients were grouped under following age intervals i.e. 41-50,51-60,61-70 and 71-80 years in both SICS and Phacoemulsification group.

In SICS and Phaco group, there was significant increase in mean schirmer value on day 1 by average of 3.07 mm and 2.12 mm in comparison to preop mean value. One significant observation in both the groups was that on first post-op day the schirmer and flourescein values significantly increased. We can find the only reason for increased value in SICS is the cauterization of conjunctival flap and more tissue handling due to large incision corneal-scleral wound which denervate corneal nerves leading to decrease in corneal sensitivity and in Phaco group there was incomplete epithelization of corneal phaco entry wound. There was significant decrease in mean schirmer value at post-op day 7 in comparison to post-op day 1 value and preop value respectively which was contrary to done by Baveja [7]. The probable decrease on mean schirmer value was use of frequent instillation of topical steroid eye drops. The steroid eye drops contain benzalkonium chloride which destabilize lipid layer, decrease mucin expressing cells and lead to increased tear evaporation and reduce tear production.

Our findings were similar to findings of Gharee *et al.* [8], Khanan *et al.* [9] who reported trend towards recovery of tear functions by 1 month after phacoemulsification. Liu *et al.* [10] reported that dry eye developed on post-op day 1 and day 2 with rapid return of tear function parameters to base line values within a month which is contrary to our findings where there the tear function values are close to baseline values at end of 2 months. Sinha *et al.* [11] showed that mean schirmer value decreased at 1 month also which contradicted our finding where we saw gradual rise of schirmer value at 1 month. Kavitha CV *et al.* [12] concluded that there was dryness after manual small cataract surgery with corneo-scleral tunnel incision which correlates with our study.

In our study TBUT was lowest at postoperative one week which gradually improved at 1 month and returned to near baseline levels at end of 8 weeks. as topical steroid drops were being tapered and stopped by 6 weeks. According to Cho YK *et al.* [13] and Liu Z *et al.* [14] cataract surgery causes significant alteration in tear breakup time. Tear film stability was compromised in present study in phaco as supported by low FTBUT values which correlates with study of Gupta M [15] in 2015 and low values in SICS with study of M. Gayatri [16]. Our findings were contrary to findings of Sinha *et al.* [11] who showed decrease in TBUT value event at I month but in our study TBUT had gradually started increasing at 1month.

In our view this OSDI scoring method to diagnose dry eye in cataract patients preoperatively and postoperatively is not suitable indicator. This is because of its gross subjective nature of the test as few Post-operative symptoms are similar To dry eye. From above we conclude that Mean OSDI score significantly decreased in the follow-up period upto 2 months in both groups which was against the finding noted by Sinha *et al.* [11] in his study that OSDI decreased steadily in follow-up period although some of tear functions tests have reached baseline values which owes to fact that probably there is improvement in visual acuity on one hand and ocular discomfort, environmental triggers on other hand. Sitompaual *et al.* [17] found out that OSDI sore decreased on post-op day 14 in patients who underwent SICS >phaco which is similar to finding on day 7 at age 41-50 and 61-70 but not at age 51-60 where value more or less equal and at age 71-80 where increase in Osdi score was more in groupA>B.

The finding of rapid decrease in tear film indices at post-op 1 week and gradually returning to baseline level correlate with study of Sinha *et al.* [11], Gharee *et al.* [8] and Khanal *et al.* [9]. According to CHO YK *et al.* [13] and Liu Z *et al.* [14] cataract surgery causes significant alteration in tear breakup time as tear film stability was significantly compromised in our study supported by low flourescein tear break-up time (FTBUT) values. Also there was variability in tear function tests in between different age intervals as with increasing age there was decrease in tear film functions which correlated with study of Schein *et al.* [18]. Patients without dry eye preoperatively didn't develop dry eye postoperatively which correlated with study done by Chao *et al.* [19].

Conclusion

Our study showed progression towards dryness post-cataract surgery from normal at pre-op values. Our study was very elaborative in terms of many post-op periods that is post-op day 1, 1st week, 4th week and 8th week at four different age intervals. We also included the values on 1st Post-op day which we don't find in any other study. But the shortcoming of study was that we didn't employed sophisticated tests to grade dry eye that is tear meniscus height(TMH), Tear osmolarity, Impression cytology (to see decrease in goblet cell density), Conjuctivial staining and tear protein assays to assess ocular surface damage. So it needs further studies to confirm our conclusion.

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