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Changes in tear film parameters after manual small incision cataract surgery

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ABSTRACT

Background: Dry eye disease is an ocular surface disorder leading to tear film instability. Causes are multifactorial, cataract surgery being one of its causes.

Purpose: To evaluate changes in the tear film parameters (Schirmer's I, Schirmer's II and tear film breakup time) and to find out the factors influencing it following manual small incision cataract surgery.

Materials and Methods: A prospective observational study was carried out in 185 eyes of 185 patients aged ≥ 50 years with age related cataract without preoperative dry eye. All the patients were evaluated for the changes in the tear film parameters at prior to the study and post operative day 7th, one month and at 3 months.

Results: Dry eye was predominantly seen in males (96, 51.89%). Majority of the patients were in the age groups 50-60 years (84, 45.4%). Dry eye was seen in 7% of patients. Majority had mild grade dry eyes (50, 79%). There was decline in the all tear film parameters peaked at seventh day followed by gradual increasing trend over one month till the last follow up. Statistically significant changes was seen in all the tear film parameters between preoperative and post operative visits ($p < 0.001$). Development of dry eye was correlated with older age, diabetes mellitus and duration of microscope light exposure time.

Conclusion: Manual small incision cataract surgery can induce decline in tear film values in early post operative period with gradually increasing trend over time. Majority of patients had mild grade dry eyes.

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1. Introduction

Dry eye disease (DED) is a multifactorial ocular surface disorder leading to ocular discomfort, tear film instability and visual changes.¹⁻⁴ Cataract is one of the causes of DED. Cataract surgeries has widely been seen to adversely affect the tear film status in the early postoperative period, hence leading to the development of dry eye, especially in patients with preexisting dry eye symptoms. It induces dry eye symptoms even in patients without preexisting dry eye symptoms, at least for the first two months post cataract surgery.^{5,6} The dry eye occurring after cataract surgery is postulated due to changes in ocular surface and

tear film stability secondary to surgically induced trauma and inflammation, decrease in corneal sensation due to surgical incision which disrupts cornea-lacrimal gland loop leading to decrease tear production, prolong use of antibiotic-steroid eye drops and exposure to light from the operating microscope.⁵⁻⁸

Manual small incision cataract surgery (SICS) is a good alternative to phacoemulsification in developing countries like ours, with potentially good visual outcome. With the incidence of cataract and number of cataract surgeries performed rapidly increasing, it is important to study the long-term effects of the surgery on the tear film parameters. Pre-operative evaluation for dry eye and factors affecting ocular stability can preserve ocular surface and prevent complications related to dry eye. Keeping this in mind, the

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present study was undertaken to find the changes in the tear film parameters using dry eye test values: tear break-up time (TBUT), Schirmer's test I (ST-I) and II (ST-II) before and after surgery.

2. Materials and Methods

This hospital based prospective study was conducted in 185 eyes of 185 patients aged ≥ 50 years of age undergoing manual SICS without pre-existing dry eye. Patients with dry eye symptoms and ocular conditions leading to dry eye were excluded from the study. Ethical clearance was sought from the Institute review committee, BPKIHS and is in accordance to the declaration of Helsinki.

After obtaining an informed consent, detailed clinical history and meticulous ophthalmological examinations were carried out to rule out pre existing ocular surface disease. A standardized form was filled out for each patient, documenting socio-demographic features, occupation, ocular complaint, any other systemic complaint and treatment history. In all the patients, tear film break up time (tBUT), Schirmer's I test (ST-I) and Schirmer's II test (ST-II) were taken.

The criteria for diagnosis of dry eye was tBUT ≤ 10 seconds, ST-I ≤ 10 mm and ST-II < 10 mm wetting over 5 minutes.³ Dry eye was graded as mild, moderate and severe.

Tear film break up time was measured by installing an impregnated 2% fluorescence strip into the lower fornix. The time interval between the last blink and the appearance of the first randomly distributed dry spot was examined under a broad beam of cobalt blue filter in a slit lamp and was graded as mild 6-8 seconds, moderate 3-5 seconds and severe 0-2 seconds.³

Schirmer's test I was done by measuring the amount of wetting of a special graded filter paper (no. 41 Whitman) of size 5 mm x 35mm without anesthesia and graded as mild 11-14mm, moderate 10-6 mm and severe 5-1mm.³

Schirmer's test II was done as ST-I provided, the eyes were pre-anesthetized with topical 4% xylocaine drops.

All the patients were started on topical eye drops 0.3% ofloxacin qid and 0.03% flurobiprofen qid one day prior to the surgery. Manual SICS was performed under peribulbar block. A standardized post operative regime was followed in all the patients. All the patients received 0.3% ofloxacin qid eye drop qid and 1% prednisolone eye drops in tapering doses for 8 weeks. Tear film parameters were evaluated at 7th day, 1 month and 3 months post operative intervals. At each visits, ST-I, ST-II and tBUT was done and were asked for any subjective symptoms of dry eyes. Additional parameters noted were, duration of surgery and exposure to microscope light time. Due to unavailability of Rose Bengal and lissamine green stain, these staining tests could not be performed.

Statistical analysis was conducted using SPSS Version 16 program. For descriptive statistics, mean, standard deviation, proportion, percentage was calculated along with graphical and tabular presentation. For inferential statistics X^2 test, paired t test or Wilcoxon sign rank and Pearson correlation test was carried out to find significant differences among the variables at 95% CI where p value is < 0.05 .

3. Results

One hundred and eighty-five patients meeting the inclusion criteria were enrolled in the study. Males outnumbered females (96, 51.89% vs 89, and 48.10%) with male: female ratio of 1.07:1. Majority of the patients were in the age groups 50-60 years (84, 45.4%), >60-70 years (34%) and >70 years (20.54%). Diabetes mellitus was seen in 50.8% (n-94). The mean age of the patient was 63.59 ± 9.53 years. All the patients had normal baseline values of ST-I, ST-II and tBUT. Preoperatively, mean Schirmer's I test value was 20.45 ± 3.76 mm. Postoperative the value progressively decreased when assessed on post operative day 7th and at one month, after which however a gradual rising trend was seen up to our last follow-up, at three months Figure 1, Table 1).

The mean preoperative Schirmer's II, value was 16.60 ± 2.92 mm. Postoperatively, the value progressively decreased when assessed on day, 7th and at one month, which gradually increased till the last follow-up (Figure 2, Table 1).

Similarly a significant decrease in the tBUT value was seen in the early postoperative period at one week ($p < 0.001$) as compared to preoperative findings with gradual rising trend noticeable at one month post operative ($p < 0.001$) and till the last follow up ($p < 0.001$) (Figure 3, Table 1)

At three months post operative visit, mean Schirmer's I, II and tBUT was 15.74 ± 3.59 mm, 14.14 ± 3.31 mm and 11.96 ± 2.03 seconds respectively. Statistically significant changes in all the tear film parameters values were noticeable at preoperative and different postoperative time intervals with p value < 0.001 (Table 1).

Dry eye was seen in 7% of patients at three months post surgery. 79.4% had mild and 20.6% moderate dryness. None of them had severe dry eye.

7% showed lower STI value, 18.9% ST II and 30% showed lower TBUT at three months post operative visit which was statistically significant ($p < 0.001$).

3.1. Correlation of microscopic light exposure time with dry eye test values

The mean surgical exposure time to microscope was 23.92 ± 6.43 minutes. Significant correlation was seen between microscope exposure time and tear film parameters, Schirmer's I and II. Though a positive correlation was seen between microscope light exposure time and TBUT at 7th

postoperative day, but was negative at one month and the last follow up (Table 2). Older age group, diabetes mellitus and microscope exposure time showed positive correlation with the occurrence of dry eye at different post operative time intervals (Table 3).

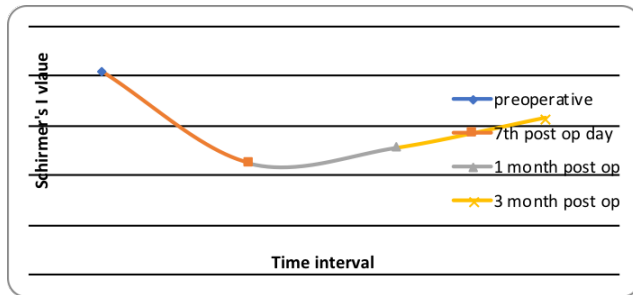


Fig. 1: Schirmer's I test values at different time intervals

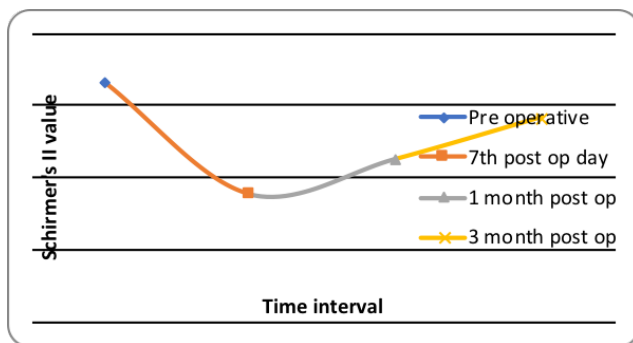


Fig. 2: Schirmer's II test values at different time intervals

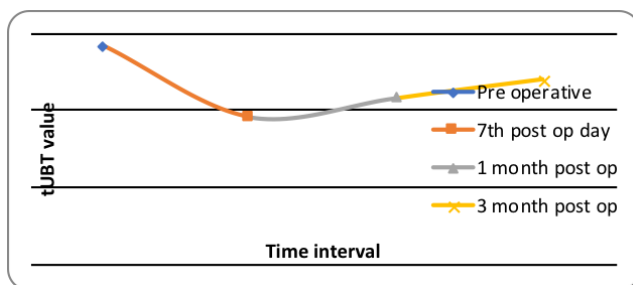


Fig. 3: Tear film break up time values at different time intervals

4. Discussion

This hospital based prospective study was carried out to determine the changes in the tear film parameters in patients undergoing manual small incision cataract surgery. The specific ocular parameters analyzed were Schirmer's test I, Schirmer's test II and tBUT at different post operative time intervals. It was also attempted to see the different risk factors affecting these parameters.

Cataract surgery has been seen to adversely affect the tear film parameters in the early post operative periods resulting in dry eye.^{6,7,9} Though transient in some situations, ophthalmologist should be aware of development of dry eye after cataract surgery which is an unsatisfying experience, hampering daily activities. In the present study the incidence of dry after surgery was 7% at three months visit which was comparable to other studies^{6,9–11} but lesser than other studies.^{12,13}

Multiple risk factors have been postulated to be associated with dry eye like older age, female gender, diabetes^{14–17} and systemic hypertension.^{16,18} In this study, male, older age group and presence of diabetes mellitus were seen to have an association with post operative dry eye.

Studies have shown that cataract surgery worsens dry eye symptoms in patients with preexisting dry eye symptoms, at least for the first two months post surgery.^{5,6} In the present study at three months postoperative visit, dry eye was seen in 7%; majority of had mild dry eyes (79.4%). There was decline in the tear film parameters during 7th post operative day with gradual increasing trend in these parameters till the last follow up at three months which was consistent with the findings in other studies.^{9,11,12,19}

Pallamreddy et al¹⁰ observed that 24% of the eyes had lower tear film meniscus height at 3 months post operative visit after manual small incision cataract surgery. 8% the eyes recorded lower tBUT values at 3 months post operative follow up, which was statistically significant ($p < 0.01$). Patients with preexisting dry eye showed lower values of tear film indices like tear film meniscus height, TBUT and Rose Bengal staining at 1 week and still lower values at 1 month. Majority of them had mild dry eye.

Ishrat et al found that 40% patients developed dry eyes in the early postoperative period. Fifteen percent and 9% of the eyes were dry at 1 month and 3 months after surgery, respectively. Majority of eyes (27/42, 64.3%) had mild dryness. There were 53.1% and 22.2% dry eyes in small incision cataract surgery and phacoemulsification groups, respectively at one week postoperative follow-up which was a statistically significant.¹¹

Unlike the present study, Chakrabroti et al, reported higher percentage of dry eye symptoms at 6 months follow (59%) in patients undergoing manual small incision cataract surgery, especially in older age groups. They found that ST I, tBUT and TMH values gradually decreased in the post operative period, more so at third post operative months.¹³

Kasetsuwan et al⁹ failed to show an association between age, gender, diabetes and hypertension with the prevalence of the dry eye after cataract surgery. The incidence of dry eye after phacoemulsification was 9.8% on 7th post operative day. Symptoms and signs of dry eye occurred as early as seven days post-operative day and the severity pattern improved over time. ST I and TBUT remained significantly lower than the preoperative level till the 90th

Table 1: Comparison of changes in different tear film parameters at different time intervals.

Parameters Pre-operative value	7 th post-op day	1 month post-op	3 3 months post op
Schirmer's Test I 20.45 ±3.76mm	11.15± 2.90 P<0.001	12.78± 2.79 P<0.001	15.74± 3.59 P<0.001
Schirmer's Test II 16.60 ±2.92 mm	8.84 ±2.33 P<0.001	11.29 ±2.64 P<0.001	14.14 ± 3.31 P<0.001
tBUT 14.14 ±1.79 second	9.52 ±1.81 P<0.001	10.86 ±1.84 P<0.001	11.96 ± 2.03 P<0.001

Table 2: Correlation of microscope light exposure time with tear film parameters

Parameters	Pearson correlation	p-value (paired t test)
Schirmer's test I		
7 th postoperative day	0.084	<0.001
1 month postoperative day	0.050	<0.001
3 months postoperative day	0.094	<0.001
Schirmer's test II		
7 th postoperative day	0.035	<0.001
1 month postoperative day	0.115	<0.001
3 months postoperative day	0.137	<0.001
TBUT		
7 th postoperative day	0.076	<0.001
1 month postoperative day	-0.012	<0.001
3 months postoperative day	-0.052	<0.001

Table 3: Correlation of different parameters and presence of dry eye at the last follow up.

Parameters	P value	Or (95% CI)
Age (years)	<0.001	0.7 (61.8-64.6)
Sex	0.78	0.9 (0.49-1.7)
Diabetes mellitus	0.007	2.3 (1.2-4.4)
Microscope exposure time (minutes)	<0.001	0.47 (22.6-24.5)

postoperative day, which are consistent with the findings in the present study.

Venugopal et al in their study reported an increased incidence of dry eye after manual small incision cataract surgery (66.2%). Among them, 53.32% had mild, 26.6% had moderate and 20% had a severe grade of dryness. 67.7% of the male and 64.9% of the female patients had dry eyes (p=0.39). 60% of the patients in the early post-operative period and 75% of the patients in the late post-operative period had dry eyes which was not significant (p=0.10).¹²

Sahu et al, observed a significant deterioration of all dry eye test values following phacoemulsification surgery along with an increase in subjective symptoms. These values started improving after one month postoperatively, but pre-operative levels were not achieved till two months after surgery.¹⁹

Microscope light exposure has been reported as a contributory factor for dry eye after cataract surgery.^{6,20,21} A longer microscope exposure time are shown to induce more severe dry eye symptoms due to instability of the tear film^{6,19} and reduction of more the goblet cell density.⁴ In the present study statistically significant positive correlation was seen between microscope exposure time and tear film test values,

Schirmer's I and II. Though a negative correlation of TUBT was noted at one month and the last follow up, it was statistically significant at different post operative time intervals.

Sahu et al reported a negative correlations of dry eye test values with the operating microscope light exposure time and (cumulative dissipated energy) CDE, but they were not significant.¹⁹ Cho and Kim too, did not observe that phaco-energy aggravates dry eye symptoms or signs.⁶ Here we have included patients with normal baseline tear film parameters only. Subjects with preoperative dry eyes and with longer follow up can provide us more confirmatory correlation.

We have observed that manual cataract surgery is capable of inducing dry eyes. Though there was an improvement in the tear film values, one month onwards following cataract surgery, patients should be informed about the possibility of development of dry eye symptoms. Studies with longer follow-up and controls are recommended to assess these changes. At the last follow up, the patients with dry eyes were prescribed with preservative free tear substitutes.

5. Conclusion

Cataract surgery can induce decline in tear film values in early post operative period with gradually increasing trend over time. Dry eye was associated with older age, diabetes mellitus and duration of microscope light exposure time. Ophthalmologists should evaluate patients for dry eye, prior and after cataract surgery so that preventative measures can be taken to decrease ocular surface morbidity.

6. Source of Funding

None.

7. Conflict of Interest

None.

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