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ORIGINAL RESEARCH

Dry eye disease before and after cataract surgery: study in a tertiary care hospital

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ABSTRACT

Objectives: To assess change in tear film status in patients undergoing small incision cataract surgery and phacoemulsification. **Material and Methods:** A sample of 200 patients was chosen out of which 150 underwent small incision cataract surgery (SICS) and 50 phacoemulsification. Tear film status was evaluated pre- and post-operatively (POD 1, POD 7, POD 21 and POD 45), with the help of Schirmer's test, Tear film break up time, Tear meniscus height and OSDI. **Results:** On the last follow up day i.e., day 45, the overall prevalence of dry eye among the 200 patients, as determined by Schirmer's Test, showed significant differences between the phacoemulsification and small incision cataract surgery (SICS) groups. In the phacoemulsification group, only 2% of patients (1 patient) experienced dry eye, while 98% (49 patients) did not. In the SICS group, 12.6% of patients (19 patients) experienced dry eye, while 72% (108 patients) did not. The difference in the prevalence of dry eye between the two groups was statistically significant (P-value = 0.029).. **Conclusion:** Any incision on cornea or ocular surface, corneal or scleral, disturbs the ocular surface. Thus, cataract surgery (SICS and phacoemulsification both) may lead to dry eye. Phacoemulsification causes much less dry eye than SICS from the early post-operative period on all the parameters. A grooved incision in SICS can aggravate the symptoms from the early postoperative period in patients without dry eye preoperatively.

Keywords: SICS Small Incision Cataract Surgery, ST Schirmer test, TMH Tear Meniscus Height, TBUT Tear Break Up Time, SICS Small Incision Cataract Surgery

INTRODUCTION

Dry eye disease is a multifactorial ocular surface disorder responsible for the different symptoms like ocular surface discomfort, grittiness, foreign body sensation and visual disturbance characterized by decreased tear film production and or increased tear film evaporation [(1).]

Tear film's osmolarity increases and the ocular surface becomes inflamed as a result, leading to, for example, aqueous layer deficiency, mucin deficiency, lipid layer deficiency, lid abnormalities and lid surface abnormalities, which are all causes of dry eye. [(2,3)] As a result of the chronic damage to eye's surface, the corneal sensitivity and tear film secretion are reduced. People with the dry eye syndrome are more likely to be elderly, suffer from connective tissue disease, have a history of allergy or antihistamine use, have undergone cataract surgery, or have diabetes [(4,5,6).]

In the world, the cataract is most common cause of blindness. Small Incision Cataract Surgery (SICS) was invented in the United States and Israel and popularized in India, where it now accounts for a major share of procedures. This combined prolonged intraoperative surgical time and exposure to the microscope, has the potential to exacerbate the symptoms of dry eye [(7).] Phacoemulsification is a contemporary cataract surgery in which the eye's internal lens is emulsified and aspirated from the eye using an ultrasonic handpiece. In their investigation, Khanal et al discovered that phacoemulsification causes a decrease in corneal sensitivity and tear physiology[(8).] Incisional denervation of corneal nerves, ultrasound (cautery)-induced free radical production, high microscope light, long time exposure during surgery, and pre- and post-operative medicines have all been linked to dry eye after phacoemulsification [(9)].

Reasons Dry eye can be exacerbated after cataract surgeries include prolonged use of antibiotic-steroid eye drops, decreased tear film break-up time due to surface irregularity at site of the incisions, decrease in mucin production from the conjunctiva secondary to incision placement, decrease in corneal sensation due

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to surgical incision which disrupts the cornea-lacrimal gland loop leading tothe decreased tear secretion, poor tear film production and stability due to surgically induced ocular inflammation and exposure to light from the operating microscope [11,12,13].

MATERIALS & METHOD

This Hospital based Comparative study was carried out in Department of Ophthalmology, Amaltas Institute of Medical Sciences, Dewas for a period 18 months. 200 patients who underwent cataract surgery, 50 patients phacoemulsification and 150 patients small incision cataract surgery (SICS) who visited ophthalmology OPD were taken for this study. Full written and verbal consent with entire study explained to the patient and patient attendants was obtained. The inclusion criteria were of consent, pre senile and senile cataract patients, patients with uneventful surgery, patients who agreed for regular follow up post-operatively and exclusion criteria were of pre-existing tear film instability due to known or unknown cause, any pre-existing ocular surface disease, intraoperative complications during surgery, traumatic cataract, cataract with glaucoma and cataract associated with long standing intraocular inflammation. The assessment of tear film status was performed pre and post-operatively over a period of 1.5 months with follow up at POD 1st ,7th, 21st, 45th day, with the help of Schirmer's test 1, Tear film break up time, Tear meniscus height and OSDI (Ocular surface disease index). In Schirmer's test 1 (without anaesthesia) the extent of wetting of 5*35mm Whatman paper strip was measured. Schirmer strip reading inference was: 0-4mm Severe dry eye; 5-9mm Moderate dry eye; 10-14mm Mild dry eye; >15mm Normal. Tear film breakup time, defined as interval between a complete blink and appearance of first dry spot- on cornea was interpreted as indicating Value <10 seconds indicating tear film instability. Tear meniscus height formed by tears was measured between eye lid margin and inferior bulbar conjunctiva where lid touches the globe with value <0.25mm taken as indicating tear film instability. Ocular surface disease index (OSDI) questionnaire was used along with the above mentioned clinical tests for screening the patients with tear film instability on three subscales: symptoms, vision related problems and environmental triggers and were rated with their response on 0 to 4 scale.

After selecting the patients based on the inclusion and exclusion criteria, prior informed consent after explaining the complete procedure of the study was taken from the patients. All the operations were performed by the same surgeon.

Statistical analysis

Software was used in statistical analysis was SPSS (Statistical Package for the Social Sciences) version 23.0. Comparative analysis was done. Continuous Variables: The mean values of continuous variables were compared between the two groups using independent t-tests. Preoperative and postoperative values at different time points were compared within each group using paired t-tests. The prevalence of dry eye and severity of dry eye was compared between the two groups using Chi-square tests or Fisher's exact tests where appropriate, with categorial variables. The comparison of proportions for categorical variables was performed to identify any significant differences between the groups. Significance Level: A p-value of less than 0.05 was considered statistically significant for all tests.

RESULTS

The study included a total of 200 patients who underwent cataract surgery. Of these, 50 patients (25%) underwent phacoemulsification, while 150 patients (75%) underwent small incision cataract surgery (SICS). There was no statistically significant difference in the age distribution between the two groups (P-value = 0.239).

Over all tests values of Schirmer's test, Tear film breakup Time, Tear meniscus height and Ocular surface disease index values were recorded.

Schirmer's test values, recorded preoperatively and at various postoperative intervals for both the phacoemulsification and small incision cataract surgery (SICS) groups, preoperative, POD 1, POD 7 , POD 21 and finally, on day 45 indicate that while both surgical techniques led to a temporary reduction in tear production postoperatively, phacoemulsification patients consistently showed better Schirmer's test values compared to SICS patients across all postoperative time points, with significant differences at each interval.

These results indicate that while dry eye was more prevalent in the immediate postoperative period, particularly in the SICS group, the prevalence decreased over time. However, the difference between the groups remained statistically significant on days 1, 7, and 45, but not onday 21.

On OSDI scoring, results indicate that both surgical techniques led to an increase in OSDI scores postoperatively, with patients in the SICS group consistently showing higher scores compared to the phacoemulsification group at each postoperative interval.

The difference between Tear Break Up Time (TBUT) was assessed preoperatively and at various postoperative intervals for both the phacoemulsification and small incision cataract surgery (SICS) groups. Tear Break Up Time results indicate that while dry eye was more prevalent in the immediate postoperative period, particularly in the SICS group, the prevalence decreased over time.

By day 45, results indicate that both surgical techniques led to a temporary reduction in TBUT postoperatively, with the SICS group consistently showing lower TBUT values compared to the phacoemulsification group at each postoperative

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interval. The differences in TBUT between the groups were statistically significant at all postoperative time points.

By day 45, there were no cases of dry eye in the phacoemulsification group (0%) and only 7.3% in the SICS group (11 patients), with no significant difference

Tear Meniscus Height results indicate that both surgical techniques led to a temporary reduction in TMH postoperatively, with the SICS group consistently showing lower TMH values compared to the phacoemulsification group at each postoperative interval. The differences in TMH between the groups were statistically significant at all postoperative time points.

On the last follow up day i.e., day 45, the overall prevalence of dry eye among the 200 patients, as determined by Schirmer's Test, showed significant differences between the phacoemulsification and small incision cataract surgery (SICS) groups. In the phacoemulsification group, only 2% of patients (1 patient) experienced dry eye, while 98% (49 patients) did not. In the SICS group, 12.6% of patients (19 patients) experienced dry eye, while 72% (108 patients) did not. The difference in the prevalence of dry eye between the two groups was statistically significant (P-value = 0.029).

Table 1: Type of Surgery

Type of Surgery	N	**%**
Phacoemulsification	50	25.0
SICS	150	75.0

Table 2: Age (n=200)

Age	**Phacoemulsification (n = 50)**		**SICS (n = 150)**	
	n	**%**	**n**	**%**
41-50	2	**4.0**	15	**10.0**
51-60	4	**8.0**	20	**13.3**
61-70	23	**46**	60	**40**
>70	21	**42**	55	**36.7**
Mean, SD	68.6	**6.67**	66.4	**7.04**
	P-value = 0.239			

Schirmer's Test (n=200)			
	Phacoemulsification (n = 50)	**SICS (n= 150)**	
Schirmer's Test	**Mean**	**Mean**	**P-value**
Schirmer's Test:Preoperative	22.0	22.1	0.951
Schirmer's Test: Day 1	15.2	13.1	0.0013
Schirmer's Test: Day 7	17.1	16.7	0.0022
Schirmer's Test: Day21	20.1	19	0.0076
Schirmer's Test: Day45	21.0	20.0	0.0035

Table 10: Prevalence of Dry Eye according to OSDI(n=200)

	Phacoemulsification (n = 50)		**SICS (n = 150)**		**P-value**
Dry Eye	**n**	**%**	**n**	**%**	
Dry Eye	**n**	**%**	**n**	**%**	
Day 1	10	**20**	90	**60.0**	0.034
Day 7	8	**16**	71	**47.3**	0.021
Day 21	3	**6.0**	40	**26.7**	0.003
Day 45	1	**2.0**	21	**14.0**	0.019

Prevalence of Dry Eye according to Tear Meniscus Height					
	Phacoemulsification (n = 50)		**SICS (n = 150)**		**P-value**
	Mean	**SD**	**Mean**	**SD**	
Tear Meniscus Height: Preoperative	0.71	0.083	0.69	0.084	0.080
Tear Meniscus Height: Day 1	0.44	0.080	0.35	0.085	0.001

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Tear Meniscus Height: Day 7	0.41	0.07	0.30	0.087	0.0002
Tear Meniscus Height: Day21	0.45	0.081	0.40	0.088	0.0002
Tear Meniscus Height: Day45	0.68	0.081	0.61	0.088	0.002

Tear Break Up Time (n=200)					
	Phacoemulsification (n = 50)		**SICS (n = 150)**		
	Mean	**SD**	**Mean**	**SD**	**P-value**
TBUT: Preoperative	16	1.31	16	1.49	0.432
TBUT: Day1	13.3	2.32	11.9	1.69	< 0.0001
TBUT: Day 7	11.3	3.22	9.11	2.46	0.0017
TBUT Day21	13.2	3.37	11.8	2.57	0.0216
TBUT: Day45	15.5	3.62	12.7	2.67	0.0081

DISCUSSION

This study mainly targeted towards comparison of tear film status in patients undergoing small incision cataract surgery and phacoemulsification. Tear film and ocular surface disorders such as dry eye can be caused by a lack of aqueous layer or by evaporative processes. Many types of ophthalmic surgeries, including cataract surgeries, photorefractive keratectomy and laser-assisted in situ keratomileusis, can result in dry eye [14,15]. The purpose of this study was to determine whether or not patient'seyes became dry after undergoing cataract surgery using manual corneoscleral tunnel incisions and phacoemulsification incisions. Preoperative and postoperative changes in dry eye symptoms and test values have been found to be significantly worsen following cataract surgery in many previous studies [16].

In our study, the mean age was 68.6 years with a standard deviation of 6.67 in the phacoemulsification group and 66.4 years with a standard deviation of 7.04 in the SICS group. There was no statistically significant difference in the age distribution between the two groups.

The gender distribution among the 200 patients included in the study was as follows: In the small incision cataract surgery (SICS) group, 51.3% were female (77 patients) and 48.7% were male (73 patients). In the phacoemulsification group, 58% were female (29 patients) and 42%were male (21 patients). The difference in gender distribution between the two groups was not statistically significant.

Regarding comorbidities among the 200 patients, the distribution of comorbidities between the two groups showed no statistically significantdifference (P-value = 0.615).

We compared distribution of past history between the cases. No significant difference was obtained in Past history distribution between those with and without dry eyes as revealed by the insignificant p value of 0.337. We also compared personal history distribution between type of eyes. No significant difference was obtained in personal history distribution between those with and without dry eyes as revealed by the insignificant p value of 0.372.

In our study, Schirmer's test values were recorded preoperatively and at various postoperative intervals for both the small incision cataract surgery (SICS) and phacoemulsification groups. Preoperatively, the mean Schirmer's test value was 22.0 mm for the phacoemulsification group and 22.1 mm for the SICS group, with no significant difference between the groups (P-value = 0.951).

On postoperative day 1, the mean Schirmer's test value decreased to 15.2mm in the phacoemulsification group and 13.1 mm in the SICS group, showing a significant difference (P-value = 0.0013). By day 7, the mean values were 17.1 mm for the phacoemulsification group and 16.7 mm for the SICS group, again showing a significant difference (P-value = 0.0022). By day 21, the mean Schirmer's test values were 20.1 mm in the phacoemulsification group and 19.0 mm in the SICS group, with a significant difference observed (P-value = 0.0076).

The prevalence of dry eye, as determined by Schirmer's test, varied between the small incision cataract surgery (SICS) and phacoemulsification groups at different postoperative intervals. Finally, on day 45, the mean values were 21.0 mm for the phacoemulsification group and 20.0 mm for the SICS group, with a significant difference noted (P-value = 0.0035). These results indicate that while both surgical techniques led to a temporary reduction in tear production postoperatively, phacoemulsification patients consistently showed higher Schirmer's test values compared to SICS patients across all postoperative time points, with significant differences at each interval.

These results indicate that while dry eye was more prevalent in the immediate postoperative period, particularly in the SICS group, the prevalence decreased over time. However, the difference between the groups remained statistically significant on days 1, 7, and 45, but not onday 21.

In Our studies of Ocular Surface Disease Index (OSDI), scores were measured preoperatively and at various postoperative intervals for both the small incision cataract surgery (SICS) and phacoemulsification groups. Preoperatively, the mean OSDI score was 7.2 with a standard deviation of 2.26 in the phacoemulsification group, and 7.8 with a standard deviation of 3.96 in the SICS group, with no

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significant difference between the groups (P-value = 0.1920). On postoperative day1, the mean OSDI score increased to 20.1 (SD = 5.09) in the phacoemulsification group and 22.5 (SD = 4.39) in the SICS group, showing a significant difference (P-value = 0.0070)

By day 45, the mean OSDI scores were 15.3 (SD = 4.8) for the SICS and 13.8 (SD = 5.31) for the phacoemulsification group, again showing a significant difference (P-value = 0.0058). The differences in OSDI scores between the groups were statistically significant at all postoperative time points.

In the present study, we also compared Tear Break Up Time (TBUT) assessed preoperatively and at various postoperative intervals for both the small incision cataract surgery (SICS) and phacoemulsification groups. Preoperatively, the mean TBUT was 16 seconds for both groups, with standard deviations of 1.31 and 1.49 respectively, showing no significant difference (P-value = 0.432).

The differences in TBUT between the groups were statistically significant at all postoperative time points.

Tear Meniscus Height (TMH) was measured preoperatively and at various postoperative intervals for both the small incision cataract surgery (SICS) and phacoemulsification groups. By day 45, the mean TMH values improved to 0.68 mm (SD = 0.081) in the phacoemulsification group and 0.61 mm (SD = 0.088) in the SICS group, with a significant difference observed (P-value = 0.002). These results indicate that both surgical techniques led to a temporary reduction in TMH postoperatively, with the SICS group consistently showing lower TMH values compared to the phacoemulsification group at each postoperative interval. The differences in TMH between the groups were statistically significant at all postoperative time points.

CONCLUSION

Majority of the patients undergoing cataract surgery had age between 61-70 years followed by age group of more than 70 years. There was no statistically significant difference in the age distribution between the two groups. The difference in gender distribution between the two groups was not statistically significant. The differences inpersonal history between the two groups were not statistically significant(P-value = 0.615).

The overall prevalence of dry eye among the 200 patients, as determined by Schirmer's Test, showed significant differences between the phacoemulsification and small incision cataract surgery (SICS) groups. In the phacoemulsification group, only 2% of patients (1 patient) experienced dry eye, while 98% (49 patients) did not. In the SICS group, 12.6% of patients (19 patients)experienced dry eye, while 72% (108 patients) did not. The difference in the prevalence of dry eye between the two groups was statistically significant (P-value = 0.029).

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