

## Evaluation of Dry Eye after Cataract Surgery

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**Objective:** To evaluate the changes in tear break up time (BUT) and Schirmer test in patients after cataract surgery and its association with the type of surgery, gender and laterality.

**Design:** A Prospective Study.

**Setting:** Jordan University Hospital, Jordan.

**Method:** Forty eyes of forty patients who underwent cataract surgery between October 2018 and January 2019 were included in the study. Thirty patients underwent phacoemulsification and ten patients underwent extracapsular cataract extraction (ECCE). All patients were evaluated preoperatively and up to 6 weeks postoperatively. Tear BUT and Schirmer test were measured at one, three, and six weeks postoperative and were compared within each group and between the two main study groups.

**Result:** Forty patients were included in this study, 22 (55%) were males and 18 (45%) were females. The average age was  $64.9 \pm 9.73$  years. Thirty (75%) patients underwent phacoemulsification and 10 (25%) patients underwent ECCE. Twenty-three (57.5%) cataracts were in the right eye and 17 (42.5%) were in the left eye. Schirmer and BUT tests taken preoperatively were compared to one, three, and six weeks postoperatively. There was a significant decrease in both Schirmer and tear BUT test at one and three weeks in both groups (P-value less than 0.05). ECCE patients had significantly lower values of both tests at one and three weeks compared to phacoemulsification patients (P-value less than 0.05). No gender or laterality difference was found between preoperative and postoperative Schirmer and tear BUT test values (all P-values > 0.05).

**Conclusion:** Cataract surgery can cause or worsen dry eye and affect the dry eye test values in the postoperative time. This holds true for both types of cataract surgery (phacoemulsification and ECCE).

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Dry eye syndrome is characterized by dryness of the ocular superficial structure due to decreased production or over- evaporation of tears<sup>1</sup>. It results in discomfort, irritation, burning, foreign body sensation, feeling of grittiness, ocular pain and fatigue<sup>2</sup>. In its severe form, it may result in serious complications such as punctate keratitis, persistent epithelial defects, filamentary keratopathy, superior limbic keratoconjunctivitis and reduced visual acuity.

Dry eye could impact the quality of life, especially in the elderly<sup>1-5</sup>. It affects patients during driving, television watching, reading and computer work; it also affects their emotional well-being<sup>6</sup>. Cataract surgery induces changes in corneal sensitivity and increases the symptoms of dry eye<sup>7</sup>. Several studies found strong associations between phacoemulsification and subsequent dry eye symptoms<sup>5,8-12</sup>. Few studies have analyzed dry eye syndrome development after extracapsular cataract extraction (ECCE) as it is becoming less popular in favor of sutureless phacoemulsification<sup>9,10</sup>. However, in many developing countries, such as Jordan, in which opacification

of the intraocular lens accounts for a significant percentage of blindness, phacoemulsification is not always available due to high cost of machines and higher density of cataracts<sup>13</sup>.

The aim of this study is to evaluate dry eye development after ECCE compared to phacoemulsification among patients.

### METHOD

Forty patients underwent cataract surgery from October 2018 to January 2019; 22 were males and 18 were females; the mean age was  $64.9 \pm 9.73$ . Twenty-three patients underwent surgery in the right eye, and 17 in the left eye. Thirty patients underwent phacoemulsification (mean age,  $64.04 \pm 9.93$ ) and 10 patients underwent ECCE (mean age,  $67.38 \pm 9.29$ ). Patients who had evidence of superficial ocular disease, lid disorders, on oral contraceptives, antihistamines, antidepressants, decongestants or acne treatment, topical eye drops for glaucoma or having an autoimmune disease were excluded. All patients underwent visual acuity assessment, slit-lamp examination refraction,

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intraocular pressure measurement using applanation tonometry and dilated fundus exam and grading of their cataracts. All patients with grade 1 to 4 nuclear sclerosis, posterior subcapsular cataract grade 1 to 4, cortical cataract and underwent phacoemulsification, and patients with grade 5 nuclear sclerosis were allocated to ECCE surgery. Informed consents were obtained from all participants. All participants were evaluated preoperatively at baseline and at 1, 3, and 6 weeks postoperatively after discontinuing the postoperative eye drops; tear BUT and Schirmer tests were evaluated.

The tear BUT test was performed at baseline and 1, 3, and 6 weeks postoperatively. Fluorescein dye was instilled in the lower conjunctival sac and the appearance of the first dark spot on the cornea was recorded as the tear BUT. The tear BUT score was averaged to detect if the patient had dry eye or not. An average score of 10 seconds or more was considered normal. A score of less than 10 seconds was considered an indicator of dry eye.

Schirmer paper strips were inserted in the junction between the lateral one-third and medial two-thirds of the lower conjunctival sac while avoiding contact with the cornea. The wetness of the strip was measured at 5 minutes. A wet area of 10 mm or less was reported as a dry eye.

All cataract surgeries were performed by the same surgeon. General and local (peribulbar, lidocaine 1%) anesthesia were used. Prior to surgery, eyes were cleaned with povidone 5%. Phacoemulsification was performed with a 3 mm temporal clear corneal incision in right eyes and slight nasal wound in left eyes. A side port of average 1 mm 90 degrees from the main incision was also used. The mean operating time was between 10 and 20 minutes; intraocular lens were inserted in all cases. For ECCE surgery, a superior corneal shelved incision of 10 mm was performed. After capsulorhexis, delivery of the lens was performed. The cortex was cleaned and a rigid intraocular lens was inserted in each eye. Closure of the wound was performed by 5 stitches of 10.0 nylon. All patients used prednisolone acetate 1% and topical ofloxacin for the first month postoperatively. The dry eye pattern based on tear BUT and Schirmer test 1 scores were evaluated. Moreover, the associations between types of surgery, side of operated eye, and gender were investigated.

SPSS version 21.0 was used for statistical analysis. Mean ( $\pm$  standard deviation) was used to describe continuous variables (i.e. age and measurements). The correlation between Schirmer and BUT preoperatively and postoperatively was studied using paired sample t-test. All underlying assumptions were met unless otherwise indicated. A P-value of 0.05 was considered significant.

## RESULT

Forty patients were included in the study; 22 (55%) were males and 18 (45%) were females. The average age was 64.9 ( $\pm$ 9.73) years; 64.56 $\pm$ 10.63 for males and 65.27 $\pm$ 9.03 for females. Thirty (75%) patients underwent phacoemulsification (mean age, 64.049.93 $\pm$ ) and 10 (25%) patients underwent ECCE (mean age, 67.38  $\pm$  9.29). Twenty-three (57.5%) were operated in the right eye and 17 (42.5%) were in the left eye.

No significant differences were found in Schirmer test values between the baseline and at one week and six weeks postoperative visit with 13.48 $\pm$ 10.36 and 13.69 $\pm$ 11.77, respectively (P-value=0.872), see table 1.

**Table 1: Schirmer and Tear BUT Test Results Preoperatively and 6 Weeks Postoperatively**

	Mean	N	Std. Deviation	P-value
Schirmer Preop	13.475	40	10.35767	0.872
Schirmer Postop	13.688	40	11.77170	
BUT Preop	10.250	40	4.54465	0.072
BUT Postop	9.150	40	4.40017	

Similarly, no significant differences were found on tear BUT test values between baseline measurements at one week and six weeks postoperative, 9.5 $\pm$ 4.5 and 9.15 $\pm$ 4.4, respectively (P-value=0.072), see tables 1 and 2. However, there was a significant difference on the Schirmer and tear BUT test between the two groups at 3 weeks (P-value less than 0.05).

**Table 2: Schirmer and Tear BUT Test Results Preoperatively and 6 Weeks Postoperatively, Phacoemulsification compared ECCE**

	Surgery	N	Mean	Std. Deviation	P-value
Schirmer Preop	Phacoemulsification	30	15.2000	11.24155	0.003
	ECCE	10	8.3000	4.24395	
BUT preop	Phacoemulsification	30	10.8000	5.05419	0.015
	ECCE	10	8.6000	1.77639	
Schirmer Postop	Phacoemulsification	30	14.0833	12.04738	0.553
	ECCE	10	12.5000	11.43338	
BUT Postop	Phacoemulsification	30	9.4000	4.73141	0.141
	ECCE	10	8.4000	3.30656	

Preoperative Schirmer test values were significantly lower in patients who underwent ECCE, measuring 8.3 $\pm$ 4.24. Patients who underwent phacoemulsification measured values of 15.2 $\pm$ 11.24 (P-value=0.003), see table 2. Preoperative tear BUT test values were lower in patients who underwent ECCE, 8.6 $\pm$ 1.78 compared to phacoemulsification, 10.8 $\pm$ 5.05 (P-value=0.015). In the phacoemulsification group, there was a significant decrease in Schirmer test and tear BUT test at one week and three weeks postoperative compared to the baseline. However, at 6 weeks, the values became insignificant when compared to the preoperative values (P-value more than 0.05). Similar changes were noted in the ECCE group.

In addition, no significant differences were found on Schirmer test values between males and females at baseline (P-value=0.706) or postoperatively (P-value=0.993), see table 3.

**Table 3: Gender Schirmer and Tear BUT Test Results Preoperatively and 6 Weeks Postoperatively**

	Gender	N	Mean	Std. Deviation	P-value
Schirmer Preop	Male	22	14.8636	10.31548	0.706
	Female	18	11.7778	10.44625	
BUT Preop	Male	22	11.0000	3.62531	0.177
	Female	18	9.3333	5.43410	
Schirmer Postop	Male	22	14.1364	11.60581	0.993
	Female	18	13.1389	12.28558	
BUT Postop	Male	22	9.0909	4.62817	0.399
	Female	18	9.2222	4.23647	

Tear BUT test values showed no significant difference related to gender, neither at baseline (P-value=0.177) nor after cataract surgery (P-value=0.399). Similarly, no significant difference was found between left eye and right eye in the Schirmer test values at baseline (P-value=0.672) or postoperatively (P-value=0.370) or in the tear BUT test at baseline (P-value=0.646) or at 6 weeks postoperative (P-value=0.406). This may indicate that the location of the surgical wound has little impact on the incidence of dry eye as right eyes had a temporal incision and left eyes had incisions at 12 o'clock, see table 4.

**Table 4: Comparison of Left and Right Eyes Schirmer and Tear BUT Test Results Preoperatively and 6 Weeks Postoperatively**

	Side	N	Mean	Std. Deviation	P-value
<b>Schirmer Preop</b>	Right	23	13.3913	10.03059	0.672
	Left	17	13.5882	11.09650	
<b>BUT Preop</b>	Right	23	9.5652	4.18684	0.646
	Left	17	11.1765	4.96532	
<b>Schirmer Postop</b>	Right	23	12.7391	11.55704	0.370
	Left	17	14.9706	12.29135	
<b>BUT Postop</b>	Right	23	8.3043	3.93625	0.406
	Left	17	10.2941	4.84465	

## DISCUSSION

Cataract, whether age-related, drug-induced or due to trauma, is currently the main cause of treatable blindness especially in the developing world<sup>14</sup>. Phacoemulsification has become the preferred method of cataract extraction over the last 15 years. The major advantage of small incision associated with phacoemulsification includes rapid recovery related to insignificant induced astigmatism<sup>14</sup>. Extracapsular cataract extraction (ECCE) can be performed in cases with dense cataract and where instrumentation is unavailable. It is widely accepted that cataract surgery is considered a risk factor for developing dry eye syndrome.

We found no difference in the Schirmer test and tear BUT test scores after 6 weeks postoperatively. The development of dry eye after cataract surgery is multifactorial with preoperative, intraoperative, and postoperative factors. Our results suggest that removal of the cataract is associated with worsening of Schirmer and tear BUT test values at one and three weeks but revert to preoperative values at 6 weeks. Most studies show decreased scores on postoperative day 1 and improvement in 1 month and 3 months postoperative<sup>15</sup>.

Patients may complain of dryness postoperatively at any time, starting from the first postoperative day, however, the highest incidence is on the seventh postoperative day<sup>15</sup>. The signs and symptoms associated with dry eye improve gradually. Tear BUT test, Schirmer I test without anesthesia, Oxford ocular surface staining system and Ocular Surface Disease Index (OSDI) questionnaire showed consistent results in evaluating dry eye postoperatively<sup>15</sup>.

In addition, we found no significant difference between ECCE and phacoemulsification in Schirmer and tear BUT test scores 6 weeks postoperatively; contrasting our expectation that ECCE will be associated with lower scores. Procedures with smaller

incisions such as phacoemulsification would be expected to cause less reduction in corneal sensitivity than ECCE and other refractive surgeries<sup>16</sup>. At 6 weeks postoperative, the cornea would have healed, which would lead to better values compared to earlier postoperative values. The effect of diabetes was not evaluated in this study, which may have affected the results.

In our study, the preoperative values of both Schirmer and tear BUT tests were significantly lower and considered as a dry eye in patients who underwent ECCE. We also found that no significant difference was found in the Schirmer or tear BUT test values between males and females either at baseline or postoperatively. This is in contrary to the well-known fact that the prevalence and severity of dry eye symptoms are higher in females, most likely due to hormonal reasons<sup>7</sup>. The average age of our patients was 64.9 ( $\pm 9.73$ ); the females were postmenopausal, thereby eliminating the gender factor. In addition, the small sample size may have affected the result.

In addition, we found no difference in Schirmer or tear BUT test values between operated right or left eyes either at baseline or postoperatively, which may indicate that the location of the wound, being temporal on the right eye and nearly vertical at 12 o'clock on the left, does not have a great impact on the development of dry eye.

The study was limited by the small sample size. More objective clinical findings should be documented because the scores measured by the tear BUT and Schirmer tests might have been inconsistent<sup>17</sup>. In addition, more factors should be included in the study, such as information about subjective symptomatology, which is the most important consideration in dry eye disease<sup>18</sup>. In spite of these limitations, our results found that dry eye disease is a transient complication occurring in the early postoperative period.

It is recommended that a large multicentric study should be performed in nearby countries with similar socio-economic conditions.

## CONCLUSION

**Dryness could occur from one to three weeks postoperatively after both phacoemulsification and ECCE cataract surgery. Cataract surgery can worsen dry eye up to 6 weeks postoperatively; this applies for both types of cataract surgeries (phacoemulsification and ECCE).**

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**Competing Interest:** None

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## REFERENCES

1. Report of the International Dry Eye Workshop. *Ocul Surf* 2007; 5(2): 75–193.
2. Mertzanis P, Abetz L, Rajagopalan K, et al. The Relative Burden of Dry Eye in Patients' Lives: Comparisons to a U.S. Normative Sample. *Invest Ophthalmol Vis Sci* 2005; 46: 46–50.
3. Garcia-Catalan MR, Jerez-Olivera E, Benitez-Del-Castillo-Sanchez JM. Dry Eye and Quality of Life. *Arch Soc Esp Oftalmol* 2009; 84: 451–8.
4. Moss SE, Klein R, Klein BE. Incidence of Dry Eye in an Older Population. *Arch Ophthalmol* 2004; 22: 369–73.
5. Li XM, Hu L, Hu J, et al. Investigation of Dry Eye Disease and Analysis of the Pathogenic Factors in Patients after Cataract Surgery. *Cornea* 2007; 26: 16-20.
6. Tan LL, Morgan P, Cai ZQ, et al. Symptomatic Dry Eye Disease in Singapore. *Clin Exp Optom* 2015; 98: 45-53.
7. González-Mesa A, Moreno-Arrones JP, Ferrari D, et al. Role of Tear Osmolarity in Dry Eye Symptoms after Cataract Surgery. *Am J Ophthalmol* 2016; 170: 128-132.
8. Ram J, Gupta A, Brar G. Outcomes of Phacoemulsification in Patients with Dry Eye. *J Cataract Refract Surg* 2002; 28: 1386–9
9. Cho YK, Kim MS. Dry Eye after Cataract Surgery and associated Intraoperative Risk Factors. *Korean J Ophthalmol* 2009; 23: 65–73
10. Kohlhass M. Corneal Sensation after Cataract and Refractive Surgery. *J Cataract Refract Surg* 1998; 24:1399–409.
11. Liu Z, Luo L, Zhang Z, et al. Tear Film Changes after Phacoemulsification. *Zhonghua Yan KeZaZhi* 2002; 38: 274–7.
12. Zabel RW, Mintsoulis G, MacDonald IM, et al. Corneal Toxic Changes after Cataract Extraction. *Can J Ophthalmol* 1989; 24: 311–6.
13. Garg A, Fry LL, Tabin G. *Clinical Practice in Small Incision Cataract Surgery: Phaco Manual*. 1st Ed. India: Jaypee Brothers Medical Publishers; 2004.
14. Kanski JJ, Bowling B. *Clinical Ophthalmology: A Systematic Approach*. 7th Ed. New York: Saunders/Elsevier; 2011.
15. Kasetuwan N, Satitpitakul V, Changul T, et al. Incidence and Pattern of Dry Eye after Cataract Surgery. *PLoS One* 2013; 8(11):e78657.
16. Hoffman RS, Fine IH, Packer M. New Phacoemulsification Technology. *Curr Opin Ophthalmol* 2005; 16(1):38-43.
17. Han KE, Yoon SC, Ahn JM, et al. Evaluation of Dry Eye and Meibomian Gland Dysfunction after Cataract Surgery. *Am J Ophthalmol* 2014; 157: 1144-1150.
18. Elksnis E, Lace I, Laganovska G, et al. Tear Osmolarity after Cataract Surgery. *J Curr Ophthalmol* 2019; 31(1): 31–35.