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Evaluation of dry eye-associated symptoms and signs after microincision cataract surgery

Pelin Ozyol[1], Erhan Ozyol[2]

[1]Department of Ophthalmology, Mugla Sitki Kocman University School of Medicine, Mugla, Turkey
[2]Department of Ophthalmology, Mugla Sitki Kocman University Training and Research Hospital, Mugla, Turkey

ABSTRACT

Objectives. To evaluate the effects of microincision cataract surgery on dry eye-associated symptoms and signs. ***Methods.*** This prospective study included 40 eyes of 32 patients. Microincision cataract surgery was performed to eyes through 2.2 mm superior clear corneal incision. Dry eye-associated symptom scoring, corneal sensitivity test, Schirmer 1 test, tear break-up time (tBUT) were measured at 3 days before and 3 days, 10 days, 1 month, 3 months after surgery. 'One way ANOVA for repeated measures', and Pearson correlation tests were used for statistical analysis. ***Results.*** The postoperative symptom scores were significantly different from preoperative value at all consecutive examinations ($p<0.01$). The decrease in superior corneal sensitivity was significant at 3 and 10 days ($p<0.001$), and recovery to preoperative level had occured at 1 month. The decrease in tBUT was significant up to 1 month ($p=0.007$ for 3 days, $p=0.008$ for 10 days, and $p=0.018$ for 1 month). The difference in Schirmer 1 test between pre- and postoperative each visit was not significant ($p=0.32$, $p=0.12$, $p=0.092$ and $p=0.088$; respectively). Symptom score was highly correlated with operative time ($r=0.72$, $p<0.01$), and there was an inverse correlation between operative time and postoperative mean tBUT values ($r=-0.52$, $p<0.01$). ***Conclusions.*** Despite microincision cataract surgery, an aggravation of dry-eye associated symptoms, and temporary dry eye-associated signs might develop. Operative time and exposure to operating microscope light seem to an important factor on symptoms and tear film stability.

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Keywords: Microincision cataract surgery; dry eye; tear film stability

Introduction

After successful cataract surgery, dry eye-associated symptoms, such as red or watery eyes, foreign body sensation, and fatigue, frequently occur and persist in some patients. Despite good visual results after surgery, dissatisfaction of patients might reduce surgical success. Some studies have reported aggravation of dry eye symptoms and signs after cataract surgery [1, 2]. Many factors, such as topical anesthesia and eye drops containing preservatives like benzalkonium chloride, surgical incision types, exposure to light from operating microscope, disrupt to normal organization of the corneal innervation,

Address for correspondence:
Pelin Ozyol, MD., Mugla Sitki Kocman University School of Medicine, Department of Ophthalmology, Mugla, Turkey
E-mail: pelingesoglu@yahool.com.tr
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might affect the ocular surface environment after cataract surgery [3-5].

The purpose of this study was to evaluate the change in tear film stability, corneal sensitivity or patients' symptoms after microincision cataract surgery, and relationships between these parameters and operative time.

Methods

Fourty eyes of 32 patients (19 men and 13 women; mean age, 65.1±8.4 years) with age-related cataract were included in this prospective study. Exclusion criteria included using of eye drops for any ocular pathology, presence of chronic ocular diseases, such as glaucoma or uveitis, disorders of the lid and nasolacrimal canal, previous ocular surgery, dry eye disease, and chronic systemic disease which might affect ocular surface, such as diabetes mellitus, collagen vascular diseases, or smokers. Patients with blepharitis, ocular allergies or pterygium were also excluded, because these factors could affect results of dry eye tests [6]. Written informed consent was obtained from each patient. The study protocol adhered to the tenets of the Declaration of Helsinki and was approved by a local ethical committee.

Phacoemulsification and intraocular lens implantation were successfully carried out by 1 surgeon in all cases and operative time was recorded for each eye. Eye drops with 2.5% phenylephrine and 0.5% tropicamide were used 3 times over half an hour to dilate pupils before cataract surgery. Topical anesthesia was achieved with 0.5% proparacaine hydrochloride. A 2.2 mm-sized clear corneal incision was made as two step grooved incision at the superior location, and two 1.0 mm-sized incisions for the side punctures were made at a 60º angle from both sides of the main incision, approximately 0.2 mm anterior to the edge of the limbal vessels. Torsional mode (OZil mode; Infinity Vision System, Alcon Laboratories Inc, Ft. Worth, TX) phacoemulsification was used for cataract surgery. All surgeries were suture-less and uncomplicated. Eye drops used after cataract surgery included moxifloxacin 4 times a day for a week, 1% prednisolone acetate 4 times daily for two weeks, 3 times daily for the third week, and 2 times a day for the fourth week. All eye drops were started 1 day after cataract surgery.

Symptom scoring, tear break-up time (tBUT), corneal sensitivity test, and Schirmer 1 test were carried out in this specific order for every patient at all visits.

Subjective symptoms were graded on a numerical scale from 0 to 4 according to the Ocular Surface Disease Index (OSDI) score [7]. The intensity of dry eye symptoms was rated from 0 to 4 as follows: 0, none; 1, mild; 2, moderate; 3, severe; 4, very severe. The frequency of dry eye symptoms was quantified as follows: 0, none; 1, some of the time; 2, half of the time; 3, most of the time; 4, all of the time. Aggravation of dry eye (when blink frequency is reduced while watching TV, driving, etc.) was quantified as follows: 0, none; 1, mild; 2, moderate; 3, severe; 4, very severe. The total score of dry eye symptoms was calculated as follows: (intensity score + frequency score + aggravation score) divided by 3. Scores ranged from 0 to 4, with higher scores indicate severe symptoms.

Corneal sensitivity was measured using a Cochet-Bonnet esthesiometer. The superior corneal surface was touched orthogonally with a defined nylon fiber. Eyelid closure was considered to be a positive response to the stimulus. The intensity of response was defined the length and the stiffness of the fiber, which was noted as millimeter.

Schirmer 1 test was measured without anesthesia. The test was lasted 5 minutes and the length of wetted paper was noted on the scale which is placed on paper. Schirmer 1 test was performed only once.

For tBUT, a fluorescein-impregnated strip wet with non-preserved saline solution was placed into inferior fornix and the patient was asked to blink several times. Using a cobalt blue filter and slit-lamp microscopy, the time which was required for the first area of tear film break-up to appear after a complete blink was noted. The test was repeated three times and the average was calculated.

All measurements were performed at 3 days before surgery, and 3 days, 10 days, 1 month and 3 months after surgery. The time interval between the tests was at least 10 minutes.

Statistical Analysis

Statistical analysis was made by using SPSS software package (SPSS 18.0). Data were analyzed by one way ANOVA for repeated measures, with Bonferroni test. The relationship between variabilities was evaluated by Pearson correlation analysis. $p< 0.05$ was regarded as statistically significant.

Results

Many patients complained of dry eye-associated symptoms, especially foreign body sensation and watery eyes after microincision cataract surgery. The symptom scores 3 days before, and 3 days, 10 days, 1 month, 3 months after cataract surgery were as follows; 0.79±1.81, 2.25±1.79, 2.29±1.53, 1.81±1.37, 1.75±1.25, respectively. The postoperative values were significantly different from the preoperative value (p<0.01 for all).

Preoperatively, the mean corneal sensitivity of superior incision location was 58.7±2.3 mm. Postoperatively, at 3 days the mean corneal sensitivity had decreased to 50.1±4.8 mm at 3 days (p<0.001) and to 53.4±5.6 mm at 10 days (p<0.001). The improvement in corneal sensitivity had continued regularly up to 1 month and recovery of corneal sensitivity to preoperative levels had occured at 1 month (Figure 1).

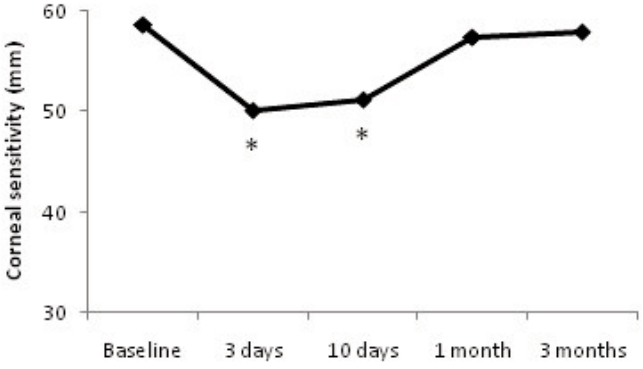

Figure 1. The mean superior corneal sensitivity from baseline to 3 days, 10 days, 1 month, 3 months (*p<0.001, Bonferroni test).

At 3 days, 10 days, and 1 month postoperatively, the decrease in tBUT was statistically significant (p=0.007, p=0.008, and p=0.018, respectively). There was no significant difference between preoperative and postoperative 3 months values (p>0.05). The difference in Schirmer 1 test between preoperative and any postoperative visits was not significant (p=0.32, p=0.12, p=0.092, p=0.088, for all consecutive visits) (Table 1).

Table 1. Changes of tear break-up time and Schirmer 1 test over time

	Preoperative	**Postoperative**			
	3 days	3 days	10 days	1 month	3 months
tBUT	11.9±2.9	6.7±3.1	6.9±2.8	8.0±4.1	9.3±3.3
p* value		0.007	0.008	0.018	0.068
ST1	12.5±3.4	13.7±4.9	13.2±4.3	12.8±3.7	12.7±5.1
***p* value&**		0.32	0.12	0.092	0.088

* Bonferroni test, compared values of tear break-up time (tBUT) between preoperative and postoperative values at specified time point, & Bonferroni test, compared values of Schirmer test 1 (ST1) between preoperative and postoperative values at specified time point.

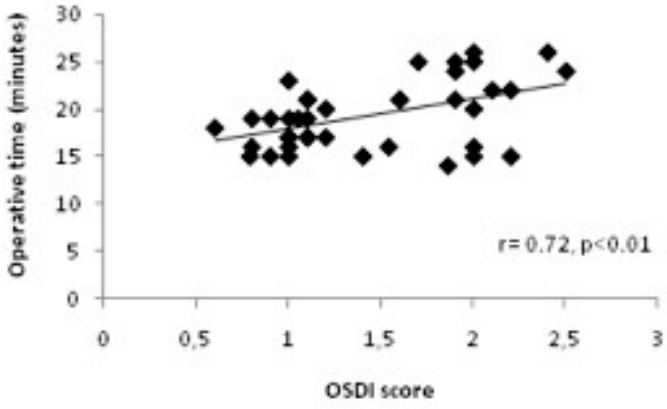

Figure 2. Correlation between OSDI score and operative time. OSDI=ocular surface disease index

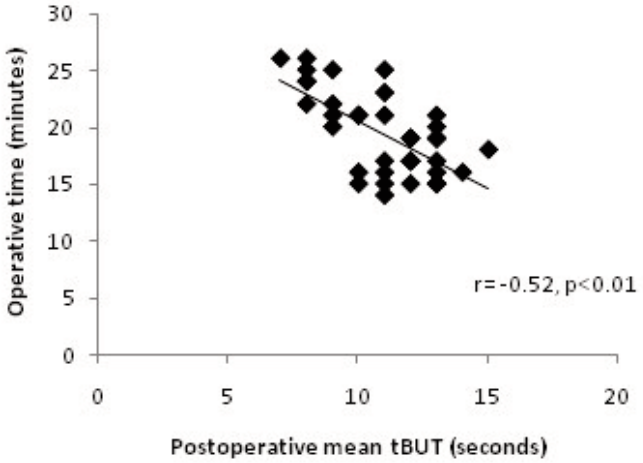

Figure 3. Correlation between tBUT values and operative time. tBUT=tear break-up time

The mean operative time was 17.4±4.9 (14-26) minutes. OSDI score was highly correlated with operative time (r= 0.72, $p<0.01$) (Figure 2), and there was an inverse correlation between operative time and postoperative mean tBUT values (r= -0.52, $p<0.01$) (Figure 3). There was no relationship between operative time and change in corneal sensitivity or Schirmer 1 test measurements ($p=0.058$ and $p=0.24$, respectively).

Discussion

In the current study, we have demonstrated that the dry eye-associated symptoms and signs increased in the early postoperative period after microincision cataract surgery. Despite microincision size which causes less damage to corneal nerves than large incision, increase of dry eye-associated symptoms and signs have indicated that the incision size is not the only mechanism of aggravation of dry eye-associated symptoms. The mechanism for the exacerbation of ocular surface damage likely includes several factors: increased inflammatory mediators due to postoperative inflammation, misuse of eye drops, toxicity from the use of benzalkonium chloride containing eye drops, decrease in corneal sensitivity which is resulted in reduced tear production, and exposure to light from the operating microscope [1-4].

Generally, dry eye-associated symptoms following cataract surgery is characterized by one of two ways. One group experienced an increase in pre-existing dry eye symptoms and the other group experienced surgically-induced dry eye. In a previous study, whether or not preoperative dry eye disease, dry eye disease symptoms occured after cataract surgery, according to NEI-VFQ25 and OSDI [1]. In our study, dissatisfaction of patients was apparent at postoperative 3 days according to symptom scores. The symptom score decreased after 10 days, but it was statistically higher than preoperative value at 1 and 3 months.

The surgical incision may potentially impact the ocular surface after cataract surgery. Historically, large incision from extracapsular cataract extractions induced damage to the corneal nerves [7, 8]. However the wounds in microincision cataract surgery seem to induce localized damage to the corneal nerves with subsequent reduced corneal sensation [6]. Sitompul *et al.* [9] reported that the corneal sensitivity decreased at the incision site and at other sites on days 1, 7, 15 after manual small-incision cataract surgery, however the change was not found statistically significant. Oh *et al.* [10] reported that the corneal sensitivity decreased significantly at 1 day postoperatively at the center and temporal incision sites, and returned to preoperative levels at 3 months after phacoemulsification with 2.8 mm corneal tunnel incision. The change in the corneal sensitivities at the other areas of the cornea was not found statistically significant. It has been reported that the corneal sensitivity had returned to preoperative levels after 3 months, in a previous study with 4.1 mm corneal incision phacoemulsification [2]. In our study, the mean corneal sensitivity of superior incision site decreased statistically significant at 3 days after micro-incisional cataract surgery with 2.2 mm clear corneal incision. The corneal sensitivity had returned to preoperative levels at 1 month postoperatively. This result indicates that the extent of incision is an important factor on recovery time of corneal sensitivity.

Depending on the damage of the corneal sensory nerves during corneal surgery, tear production decreases due to interruption of the message for tear production stimulation. Therefore, temporary dry eye symptoms might develop until the nerves regenerate again [2, 10]. Most surgical procedures, especially surgical incisions that cause denervation of the cornea, also result in impaired epithelial wound healing, increased epithelial permeability, decreased epithelial metabolic activity and loss of cytoskeletal structures associated with cellular adhesion [5]. The changes in tBUT and Schirmer tests have been reported in previous studies [1, 2, 4, 9-11]. In our study, compared with before surgery, tBUT was markedly decreased at 3 days and slightly improved up to 3 months, but it was still lower than baseline at 3 months. The change in Schirmer 1 test was not statistically significant. Irregularity of epithelium might have a role in decreased tBUT, but not in Schirmer 1 test. Small incisions may not impair reflex tear production due to less corneal sensory nerve damage.

Hazards from the optical radiation of an operating microscope can cause damage at the corneal, lenticular, and retinal levels [12]. Oh *et al.* [10] reported a decrease in the number of goblet cells in eyes with longer operative times because of more exposure to operating microscope light. We observed that for eyes which have longer operative times, dry

eye-associated symptoms according to OSDI score were more severe. After that we investigated the relationships between operative times and tear film stability tests, and found an inverse correlation between operative time and tBUT. Probably, decrease in tBUT is an important factor on dry-eye associated symptoms.

The limitations of this study

The limitations of this study were short follow-up period, and lack of histopathologic evaluation, which demonstrate squamous metaplasia and goblet cell loss.

Conclusions

In conclusion, despite microincision cataract surgery, we observed an aggravation of dry eye-associated symptoms and a decrease in corneal sensitivity and tBUT. The improvement of tests continued up to 1-3 months. However tBUT and OSDI scores had not returned to preoperative values. For this reason, patients' symptoms can be related to change in tBUT. Additionally, operative time seems an important factor on symptoms and tear-film stability. Therefore it is important to shorten the operative time and exposure to operating microscope light.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

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