



# The impact of upper eyelid blepharoplasty with or without fat excision on dry eye parameters: A comparative study

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### Abstract

**Aim:** Upper eyelid blepharoplasty (ULB) is a prevalent aesthetic and functional surgery. This study aims to compare the post-operative dry eye syndrome (DES) symptoms and related diagnostic tests between the patients who underwent ULB with or without fat excision.

**Materials and Methods:** A total of 44 patients (22 with fat excision, 22 without) were evaluated preoperatively and post-operatively in the 1<sup>st</sup> and 6<sup>th</sup> months for DES parameters (Schirmer I, tear break-up time, and corneal staining score) and Ocular Surface Disease Index (OSDI) score.

**Results:** Patients undergoing ULB regardless of fat excision demonstrated favorable outcomes in both objective DES tests and subjective DES scale in the postoperative 6<sup>th</sup> month. There was no significant difference between the two surgical groups in terms of DES parameters in both the 1<sup>st</sup> and 6<sup>th</sup> months.

**Conclusion:** ULB appears to ameliorate both objective and subjective manifestations of DES. The inclusion of fat excision during the procedure does not seem to exert a significant effect on these outcomes.



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## Introduction

Upper eyelid blepharoplasty (ULB), a frequently performed surgical procedure, is sought after for various reasons, ranging from rejuvenating the periorbital area to restoring visual fields obstructed by excessive skin [1]. While the functional and aesthetic benefits of the procedure are widely acknowledged, post-operative complications can pose significant challenges for both the patient and the clinician [2].

One of the commonly reported post-operative complications is dry eye syndrome (DES), characterized by symptoms of ocular discomfort, visual disturbances, and tear film instability [3]. Such symptoms can significantly impact a patient's quality of life and satisfaction with the surgical outcome. Previous studies have postulated a potential relationship between blepharoplasty and the exacerbation or emergence of dry eye symptoms.

Factors such as changes in the ocular surface area, poor eyelid closure, and alterations in blink mechanics have been identified as potential contributors to these symptoms post-surgery [4].

Within the diverse techniques of blepharoplasty, the decision to excise or reposition the orbital fat remains a subject of debate and variation among surgeons [5]. Fat removal can influence the eyelid's contour and function, potentially adding another layer of complexity to post-operative ocular symptoms. However, there's a paucity of literature directly comparing the dry eye symptoms between patients who undergo upper eyelid blepharoplasty with fat removal versus without.

This study seeks to bridge this gap in knowledge by evaluating and comparing dry eye symptoms and associated diagnostic test outcomes between ULB patients with and without fat excision. The findings aim to provide clinicians with more comprehensive information to guide pre-operative counseling and post-operative care, ensuring optimal patient outcomes.

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## Materials and Methods

### Study population

This retrospective study examined the right eyes of the patients who underwent ULB surgery at Karadeniz Ereğli State Hospital between June 2019 and June 2022. The sample size required for each group was determined using G-Power software with an alpha value of 0.05 by using previous studies in the literature, resulting in a minimum of 20 participants per group. Among these patients, those who underwent previous or concurrent eyelid surgeries (browpexy, lower eyelid surgery) or rejuvenation procedures (Botox, Plexr laser, filler) in addition to ULB were excluded. Patients previously diagnosed and treated for dry eye, those using medications affecting tear production or ocular surface health, and those actively treated for other ocular surface diseases were not included. Additionally, individuals newly diagnosed with dry eye during the follow-up, those who missed their follow-up appointments, and those who had any missing study parameter were also not included in this study. After exclusion criterias were applied, a total of 44 patients were included in this study. Of these patients, 22 had fat removal during their surgery (Group A), while the other 22 did not (Group B). This study complies with the Declaration of Helsinki and the study protocol was approved by the local ethics committee (Zonguldak Bülent Ecevit Non-Interventional Clinical Research Ethics Committee). Informed consent was waived due to the retrospective nature of the study.

### Surgical procedure

During the surgery, after a standard cleaning of the surgical area, the dermatochalasis (excess skin) is marked with a marker pen. Following this, a subcutaneous lidocaine HCl 2% (Jetokain Simplex® ampoule, ADeKA, Istanbul, Turkey) was applied. A skin incision is then made using a scalpel, and the excess skin is removed with the Colorado microneedle tip, using the 10-W setting for both cutting and coagulating. For patients with medial fat herniation, the surgical plan included fat excision in addition to skin removal. In instances where fat excision is performed, anesthetic is injected into the medial fat pack, after which the orbicularis oculi muscle and orbital septum are perforated. Herniated fatty tissue is excised after cauterization to manage bleeding. The orbicularis oculi muscle is then closed using a 6.0 vicryl. The procedure concluded with the skin being sutured using a 6.0 prolene with a single-stitch closure method. The surgeon left at least 20 mm of residual eyelid skin during both techniques to prevent lagophthalmos. Topical bacitracin and neomicin (Thiocilline® ophthalmic pomad, Abdi Ibrahim, Istanbul, Turkey) was prescribed for the postoperative course. Stitches are removed on the 10<sup>th</sup> day following the surgery, and patients are scheduled for follow-up visits at the 1<sup>st</sup> and 6<sup>th</sup> months post-operatively.

### Evaluation of dry eye

To investigate the presence of dry eye, all patients undergoing surgery were routinely subjected to the Schirmer I test, tear break-up time (TBUT), and staining of the cornea with fluorescein before the surgery and during follow-ups

[6]. The Schirmer I test quantifies overall tear production, including both reflex and basal tears. To perform the test, a sterile filter paper strip is inserted at the junction of the middle and lateral thirds of each lower eyelid without prior application of anesthetic eye drops. The amount of wetting is then measured by leaving the paper strip on the lower eyelid for five minutes. An abnormal result for a Schirmer I test is typically defined as a measurement of less than 10 mm of wetting in 5 minutes. TBUT evaluation consists of instilling fluorescein on the corneal surface and observing the time interval for developing hypofluorescent areas of pre-corneal tear film using a slit lamp under broad cobalt blue light. A TBUT measurement of <10 seconds is typically considered abnormal. Finally, the corneal surface staining involves the instillation of fluorescein dye to detect any abnormalities or punctate epithelial erosions under cobalt blue illumination. This evaluation follows the guidelines proposed by the US National Eye Institute, where the corneal surface is divided into five regions [7]. The extent of punctate staining in each area is graded on a scale from 0 to 3: 0 indicates no staining, 1 represents fewer than 15 dots, 2 corresponds to 16-30 dots, and 3 indicates more than 30 dots, strip/bulk staining, or the presence of corneal filaments. The cumulative corneal staining score (CSS) ranges from 0 to 15.

### Symptom assesment

The patient's symptoms were evaluated using the Ocular Surface Disease Index (OSDI) scale [8]. The OSDI consists of 12 questions divided into three categories: ocular symptoms (such as sensations of grittiness, soreness, or pain), visual function (related to the frequency of blurred or reduced vision), and environmental triggers (exposure to factors like wind, low humidity, or air conditioning). Each question is rated on a scale from 0 to 4. To calculate the final score, the sum of the scores for all answered questions is multiplied by 25 and then divided by the total number of questions answered. This calculation yields a final score ranging from 0 to 100. Based on this score, the patient is classified as either not having dry eye or falling into one of the dry eye categories: mild, moderate, or severe.

### Statistical analysis

In this study, only data from the right eyes were included in the analysis. Tabulated results are presented as mean  $\pm$  standard deviation. The normality of the data was assessed using the Shapiro-Wilk test. To test if there is any difference in Schirmer I, TBUT value, CSS, and OSDI scores between the two groups, an independent sample t-test was conducted for both preoperative and 1st and 6th month postoperative time periods. To compare the Schirmer I, TBUT value, CSS, and OSDI scores at three distinct time points of the same patient, we conducted a repeated measures ANOVA test for parametric variables and employed the Brunner and Langer model (F1-LD-F1) for nonparametric variables. Additionally, correlation analysis was performed between OSDI scores and DES parameters, including Schirmer I, TBUT value, and CSS, at both the 1<sup>st</sup> and 6<sup>th</sup> postoperative months. Data analysis was

conducted using SPSS Vers. 25 software. In all study, p values  $<0.05$  were considered to be statistically significant.

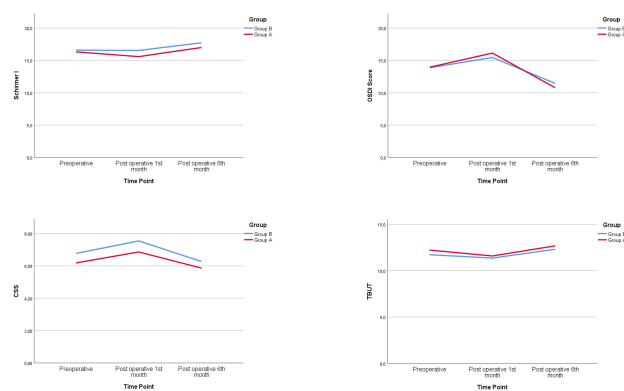
## Results

Forty-four patients, comprising 31 females and 13 males, with a mean age of  $50.3 \pm 6.9$  (39-66) years, participated in the study. Of these, 22 patients underwent additional fat excision during ULB, while 22 did not. All participants reported satisfaction with the surgical outcomes, and no complications, such as wound infections or lagophthalmos, were observed within the 6-month postoperative period.

There was no significant difference in any of the DES parameters between two surgical groups at all time points ( $p>0.05$  for all). The mean TBUT, Schirmer I, CSS and OSDI scores for Group A and Group B at the preoperative, 1<sup>st</sup> month postoperative and 6th month postoperative periods were given in Table 1. Both surgical groups displayed similar patterns of change in those parameters from the preoperative period to the 1<sup>st</sup> month postoperative and from the 1<sup>st</sup> month postoperative to the 6<sup>th</sup> month postoperative. Figure 1 shows the change patterns of all study parameters for both study groups at different time points.

In all study patients, there were no statistically significant differences in TBUT ( $p=0.072$ ) and Schirmer I ( $p=0.138$ ) values between the preoperative period and the 1<sup>st</sup> month postoperatively. However, significant differences were observed in both parameters at the 6<sup>th</sup> month compared to the preoperative period ( $p = 0.031$  for TBUT and  $p = 0.002$  for Schirmer I). CSS exhibited a statistically significant change at the 1<sup>st</sup> postoperative month ( $p< 0.001$ ) but not at the 6<sup>th</sup> postoperative month ( $p=0.05$ ). OSDI scores showed significant changes at both the 1<sup>st</sup> ( $p<0.001$ ) and 6th ( $p<0.001$ ) months compared to the preoperative period. Table 2 provides the mean values of all study parameters at these three time points.

During the postoperative 1<sup>st</sup> month, OSDI scores exhibited a significant positive correlation with CSS and a significant negative correlation with both TBUT and Schirmer I values. In the postoperative 6<sup>th</sup> month, the correlations



**Figure 1.** The change patterns of all study parameters for skin-only incision (Group A) and skin and fat removal (Group B) groups at different time points CSS, corneal staining score; OSDI, ocular surface disease index; TBUT, tear break-up time.

between OSDI scores and the other study parameters followed a similar pattern as in the 1<sup>st</sup> month, albeit with a reduced strength of correlation. Detailed correlation analyses between OSDI and dry eye parameters in both the 1<sup>st</sup> and 6<sup>th</sup> postoperative months are presented in Table 3.

## Discussion

This study compares both subjective and objective DES parameters before and after surgery in patients who underwent bilateral ULB, contrasting the skin-only technique with the combined skin and fat removal method.

In recent years, ULB has consistently been among the top three most commonly performed facial cosmetic procedures in Turkey for both men and women. Dermatochalasis and steatoblepharon rank among the primary indications for ULB [9]. It is noteworthy that these conditions are predisposed by various risk factors, such as senescence, recurrent eyelid edema, elevated body mass index, and active tobacco use [10]. Concurrently, DES manifests with similar predisposing factors, encompassing advanced age, active tobacco consumption, and persistent eyelid swelling. The confluence of these risk profiles necessitates astute consideration, as a significant cohort of patients seeking blepharoplasty may either exhibit pre-existing DES or be susceptible to its onset post-operatively [11].

There are controversial results about the effect of ULB on DES signs and symptoms. Yet the postoperative period that follows ULB has been described as “highly dynamic,” with studies showing that even if DES metrics worsen acutely after surgery, they ultimately return to baseline or get better within 3–6 months [12,13]. On the other hand, there are several studies showing that DES sign and symptoms may stay worse compared to the preoperative period after long follow-up periods [14,15].

In our study, the CSS score exhibited a significant deterioration in the first month relative to the preoperative baseline; however, by the sixth month, it reverted to values akin to the preoperative period. Violating the orbicularis muscle and upper eyelid skin was related to a temporary reduction in corneal and lid sensation due to damage to the trigeminal nerve branches which is responsible for corneal epithelial turnover [16]. Moreover, the increase in proinflammatory cytokines and opioid peptides observed shortly after surgery due to inflammation may contribute to the disruption of corneal epithelial turnover, subsequently leading to corneal epithelial staining [17]. Similar to our results, Aksu Ceylan et al. [5] found increased CSS in ULB patients during the acute period, including the 1<sup>st</sup> week and 1<sup>st</sup> month after surgery. The termination of this temporary stage, combined with improvements in objective DES parameters, might account for the more favorable outcomes observed in the 6<sup>th</sup> month compared to 1<sup>st</sup> month in CSS.

We observed that even though TBUT and Schirmer I values decreased during the 1<sup>st</sup> month follow-up, this change was not statistically significant. But, during the 6<sup>th</sup> month, favorable results in both parameters were observed. Similar to our pattern, Zhao et al. [12] found that although TBUT shortened during the 1<sup>st</sup> month after ULB, in which both orbicularis muscle and fat removal were performed,

**Table 1.** Comparison of OSDI and dry eye syndrome parameters between the two surgical groups at different time points.

Ocular surface parameters	Group	Pre-operative period	Post operative	
			1 <sup>st</sup> month	6 <sup>th</sup> month
Schirmer I	A	16.31 ± 3.13 (12.00 – 23.00)	15.59 ± 3.17 (12.00 – 22.00)	17.00 ± 3.08 (12.00 – 22.00)
	B	16.59 ± 2.88 (12.00 – 23.00)	16.54 ± 3.26 (11.00 – 25.00)	17.72 ± 3.61 (11.00 – 23.00)
P value between two groups		0.76	0.33	0.47
TBUT	A	12.22 ± 1.47 (10.00 – 15.00)	11.59 ± 1.29 (10.00 – 14.00)	12.68 ± 1.04 (10.00 – 14.00)
	B	11.72 ± 1.54 (10.00 – 15.00)	11.36 ± 1.25 (10.00 – 14.00)	12.31 ± 1.28 (10.00 – 14.00)
P value between two groups		0.27	0.55	0.30
CSS	A	6.18 ± 1.46 (3.00 – 9.00)	6.86 ± 1.35 (4.00 – 9.00)	5.86 ± 1.72 (3.00 – 9.00)
	B	6.77 ± 2.04 (2.00 – 9.00)	7.54 ± 1.68 (3.00 – 9.00)	6.27 ± 1.93 (2.00 – 8.00)
P value between two groups		0.27	0.14	0.46
OSDI	A	13.95 ± 2.51 (9.00 – 19.00)	16.13 ± 2.91 (11.00 – 20.00)	10.77 ± 2.15 (6.00 – 15.00)
	B	13.86 ± 2.79 (8.00 – 18.00)	15.45 ± 3.01 (10.00 – 21.00)	11.45 ± 2.70 (6.00 – 15.00)
P value between two groups		0.91	0.45	0.36

CSS, corneal staining score; OSDI, ocular surface disease index; TBUT, tear break-up time. Groups were compared with independent sample t test (p values <0.05 were considered to be statistically significant).

**Table 2.** Comparison of study parameters at baseline, 1<sup>st</sup> and 6<sup>th</sup> months after surgery.

Ocular surface parameters	Preoperative	Postoperative			P value
		1 <sup>st</sup> Month	6 <sup>th</sup> month	Post 1 <sup>st</sup> month VS preoperative	
TBUT	11.97 ± 1.51 (10.00 – 15.00)	11.47 ± 1.26 (10.00 – 14.00)	12.5 ± 1.17 (10.00 – 14.00)	0.072	<b>0.031</b>
Schirmer I	16.45 ± 2.98 (12.00 – 23.00)	16.06 ± 3.21 (11.00 – 25.00)	17.36 ± 3.21 (11.00 – 23.00)	0.138	<b>0.002</b>
CSS	6.47 ± 1.78 (2.00 – 9.00)	7.20 ± 1.54 (3.00 – 9.00)	6.06 ± 1.82 (2.00 – 9.00)	<b>&lt;0.001</b>	0.05
OSDI	13.90 ± 2.63 (8.00 – 19.00)	15.79 ± 2.95 (10.00 -21.00)	11.11 ± 2.44 (6.00 – 15.00)	<b>&lt;0.001</b>	<b>&lt;0.001</b>

CSS, corneal staining score; OSDI, ocular surface disease index; TBUT, tear break-up time. Repeated measures ANOVA test for parametric variables and the Brunner and Langer model (F1-LD-F1) for nonparametric variables were conducted (p values <0.05 were considered to be statistically significant).

**Table 3.** Correlation analysis between OSDI score and dry eye syndrome parameters during 1<sup>st</sup> month and 6<sup>th</sup> month.

At 1 <sup>st</sup> month			
	Schirmer I	BUT	CSS
Schirmer I	<b>1</b>		
BUT	.477**	<b>1</b>	
CSS	-.610**	-.596**	<b>1</b>
OSDI	-.799**	-.527**	.670**
At 6 <sup>th</sup> month			
	Schirmer I	BUT	CSS
Schirmer I	<b>1</b>		
BUT	.410**	<b>1</b>	
CSS	-.340*	-.093	<b>1</b>
OSDI	-.416**	-.386**	.489**

\*. Correlation is significant at the 0.05 level (2-tailed).

\*\* . Correlation is significant at the 0.01 level (2-tailed).

CSS, corneal staining score; OSDI, ocular surface disease index; TBUT, tear break-up time

it improved at the 6<sup>th</sup> month in subjects without preexisting dry eye. Yet, the authors observed no significant changes in both TBUT and Schirmer I results at 6<sup>th</sup> month follow-up visit compared to preoperative period. In an-

other study in which fat-conserving ULB was performed, no significant difference was found in TBUT and Schirmer values during the 3<sup>rd</sup> month follow up compared to baseline [18]. On the other hand, Turker et al. [19] found worse TBUT and Schirmer outcomes at the 3<sup>rd</sup> postoperative month after ULB with muscle excision and fat removal in patients with orbital fat prolapse. Those different results may stem from different surgical techniques and different study time frames, as well as the dry eye status of the patients preoperatively.

In our study, we observed a consistent trend between the fluctuations in OSDI scores and the changes in Schirmer I and TBUT values. The OSDI scores, which increased in the first month compared to the preoperative period, decreased significantly in the sixth month. This trend could be attributed to alterations in objective DES parameters. Additionally, patients' positive emotions due to satisfactory aesthetic results and a general alleviation of ocular discomfort might also play a role in more favorable OSDI scores at final visit. Supporting this hypothesis, Mian et al. [4] noted a reduction in patients' subjective dry eye complaints postoperatively, though no significant variations were identified in objective dry eye assessments.

Research on mice with alkali-induced corneal injuries has revealed that stem cells derived from orbital adipose tissue expedite corneal re-epithelialization while mitigating

corneal edema. Topical application of these cells may serve as a therapeutic agent to enhance corneal healing and curtail inflammation [20]. Though these effects have been substantiated at the cellular level, no research to date, to our knowledge, has explored the implications of the medial or central fat pad within the human orbit on corneal healing or DES parameters. In our study, we aim to compare patients who have undergone orbital fat excision with those who haven't during ULB to discern whether the functional implications of the orbital fat pad, not its cellular effects, combined with the violations of the orbicularis muscle and septum, impact the severity of DES parameters. When the orbicularis oculi muscle is violated during an ULB, it could result in changes in the blink mechanism. Such changes may contribute to diminished mechanical distribution of the tear film, decreased lipid secretion from the meibomian glands, and impaired drainage of tears from the ocular surface [3,21]. Consequently, this may lead to sensations of irritation and/or manifestations of dry eye symptoms. Although we perforated the orbicularis oculi muscle and orbital septum to reach the upper fat pads during the surgery, we didn't excise any part of the orbicularis muscle but only fat. Therefore, we may assume that orbicularis function is better preserved compared to those with orbicularis excision in prior literature [4,22,23]. Moreover, the correction of abundant tissue in the upper eyelid with fat removal may also improve mechanical eyelid function and alleviate dry eye complaints. A bulging fat pad may increase the effort to keep the upper eyelid open by increasing the muscle tone and reduce the blink frequency which may deteriorate DES findings [24]. Yet, while DES parameters did not differ between Group A and Group B throughout the study's time points, such uniformity could possibly stem from the compounded influence of the aforementioned mechanisms on tear dynamics.

In modern surgical practice, there's an increasing emphasis on maintaining youthful fullness in the upper eyelids. Many surgeons opt for a conservative approach during ULB by preserving the orbicularis oculi muscle and orbital fat when no evident fat pad bulging exists. Yet, for cases with noticeable bulging, fat excision remains the preferred technique to achieve optimal aesthetics. Kiang et al. [25], in their randomized, prospective, single-blinded study using the fellow eye as an internal control, established that muscle-sparing ULB achieves aesthetic results on par with traditional blepharoplasty that involves muscle removal. Moreover, it significantly curtails complications like lagophthalmos and dry eye disease. Informed by these findings, our approach avoids excising the orbicularis oculi in ULB surgery, reserving fat excision solely for cases exhibiting fat bulging.

At present, there is not a single "gold standard" test for DES screening in blepharoplasty patients [26]. Even objective tests can yield varying results, and these may not consistently align with subjective scales [27,28]. Hence, we opted to assess DES signs and symptoms using a combination of the most commonly employed objective tests and a subjective scale. Our observations indicated that OSDI scores were negatively correlated with increased Schirmer and TBUT values, yet they were positively correlated with CSS at both the 1<sup>st</sup> and 6<sup>th</sup> months postoperatively. While

we identified a consistent relationship among those tests, we recommend that future studies delve deeper into assessing the inter-test reliability of DES parameters. Such studies could aid surgeons in judiciously selecting the most effective tests for DES screening and post-ULB risk assessment.

Our study has several limitations. We did not stratify by gender, and the majority of our patients were females. However, ULB is predominantly performed in women, who represent over 80% of ULB procedures in the developed world [1]. We were unable to conduct more detailed tests such as tear osmolarity, tear film meniscus, meibomography, tear inflammatory markers, and impression cytology to evaluate DES due to technical constraints. Nevertheless, an in-depth evaluation of dry eye using these specific tests was beyond the scope of our study. By combining the most commonly used objective tests and a subjective scale, and considering a relatively larger patient sample compared to previous studies, we are confident our findings offer valuable insights to the literature on the effects of ULB on DES.

## Conclusion

In conclusion, our findings suggest that ULB, whether combined with fat excision or not, can yield positive outcomes in both objective DES parameters and subjective DES scale. Studies with a larger sample size and utilizing more comprehensive diagnostic tests for dry eye syndrome may further validate our findings.

## Ethical approval

Approval was received for this study from the Zonguldak Bülent Ecevit Non-Interventional Clinical Research Ethics Committee (2023/16).

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