Ocular surface and tear film changes after eyelid surgery

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Abstract: Eyelid surgery is widely and extensively used in facial plastic and reconstructive surgeries. There are many categories of eyelid surgeries, the most common of which include blepharoplasty, ptosis surgery, and eyelid reconstruction. In many cases, these procedures are combined, and there are many different techniques for each type of operation. Upper eyelid blepharoplasty usually includes the excision of skin, preseptal orbicularis oculi muscle, and orbital fat. Common methods of lower eyelid blepharoplasty are the skin-muscle flap, the skin flap, and the transconjunctival. Ptosis surgery is mainly divided into three types: transcutaneous, transconjunctival, and sling surgery. Surgeons often used the Hughes or Cutler-Beard Bridge Flaps in eyelid reconstruction. Different types and methods of surgery have their own advantages and disadvantages, and postoperative complications may occur. Therefore, postoperative complications of eyelid surgeries, such as dry eye symptoms, should be taken into serious consideration. Relevant literature involving these complaints can be found in PubMed by searching the terms “dry eye”, “eyelid”, “surgery”, and other related keywords. Moreover, various ocular surface and tear film alterations may be detected using the Ocular Surface Disease Index (OSDI), tear film breakup time, Schirmer test, fluorescein staining, and lissamine green staining after various eyelid surgeries. As dry eye disease is prevalent in the general population, it is more urgent to figure out what we can learn from these complaints. Further exploration in this field may help surgeons to choose a better surgical method and give an accurate evaluation of the postoperative effect.

Keywords: Ocular surface; tear film; dry eye syndrome (DES); eyelid surgery

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Introduction

Cosmetic and functional eyelid surgery is one of the most common facial plastic surgeries. The eyelids serve aesthetic and operational purposes. Cosmetically, the eyelid region is essential for facial beauty and aging. Functionally, the primary function of the eyelid is to protect the cornea by distributing tears over the cornea and adjusting the physiological flow of the tears. Successful surgery can preserve the essential functions of the eyelids while maintaining proper symmetry and aesthetic proportions.

Dry eye syndrome (DES) is a recognized sequela of eyelid surgery (1,2). It is one of the most common eye diseases, with a prevalence ranging from 5% to 50% (3). TFOS DEWS II revised the definition of dry eye as “a multifactorial disease of the ocular surface characterized by a loss of homeostasis of the tear film and accompanied by ocular
symptoms, in which tear film instability and hyperosmolarity, ocular surface inflammation and damage, and neurosensory abnormalities play etiological roles” (4). The unreliability of objective tear production tests suggests that a better understanding of eyelid anatomy and physiology is needed to minimize dry eye after eyelid surgery (5).

Unfortunately, few studies were published to assess DES associated with eyelid surgery. Besides, these studies reported different and sometimes contradictory results. Since these studies included various eyelid surgeries and operation techniques, they seem to be very difficult to compare different outcomes. Finally, the existed randomized controlled studies of eyelid surgery usually focus on aesthetic results rather than functional effects, especially in dry eye diseases. Therefore, to deepen the understanding of this topic, a systematic review was conducted to assess the dry eye symptom following eyelid surgery.

Methods

PubMed database search, including the keywords “dry eye”, “eyelid”, and “surgery” was performed (for the full list of keywords, see Appendix 1). Besides, we further screened relevant studies missed in the search by checking reference lists of the full-text papers. Studies were eligible for eyelid surgery, and dry eye symptom variables were assessed before and after surgery. The subjects were adult patients (over 18 years of age) with no further age limit and no gender or ethnicity restrictions. The intervention in eligible studies included upper blepharoplasty, lower blepharoplasty, ptosis surgery, eyelid reconstruction, etc. Ocular Surface Evaluation variables were comprised of subjective and objective evaluation. Subjective ocular surface evaluation commonly included the Ocular Surface Disease Index (OSDI), Salisbury Eye Evaluation Questionnaire, and McMonnies dry eye score. The objective evaluation contained tear film breakup time (TBUT), Schirmer test, fluorescein staining, lissamine green (LG) staining, and other parameters. Eligible studies included randomized controlled trials, cohort studies, and case series of ten or more participants, excluding case series of no more than ten participants and case reports and non-English articles. In the study screening process, the titles and abstracts were assessed first, and then the full texts were determined to see when the study met the inclusion criteria. An overview of the study selection is shown in Figure 1.

Results

Through the PubMed search, 209 studies were screened, of which 67 full-text articles were assessed for eligibility. In the end, 15 articles were deemed suitable for inclusion in this review (Table 1). In these articles reviewed, eyelid surgery
Table 1: Study characteristics

<table>
<thead>
<tr>
<th>Author(s) and year of publication</th>
<th>No. of participants</th>
<th>Surgical technique</th>
<th>Mean age (years)</th>
<th>Gender</th>
<th>Incidences of DES</th>
<th>DES questionnaire</th>
<th>BUT</th>
<th>Schirmer Test</th>
<th>Fluorescein staining</th>
<th>Lissamine green staining</th>
<th>Other parameters of Follow-up (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossel et al. (2003)</td>
<td>69</td>
<td>Upper BLE (orbital fat was not removed)</td>
<td>58</td>
<td>79% female</td>
<td>21%</td>
<td>N.S post-op (P&gt;0.05)</td>
<td>N.S post-op (P&gt;0.05)</td>
<td>N.S post-op (P&gt;0.05)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Prischnann et al. (2013)</td>
<td>892</td>
<td>Lower BLE: skin-flap, transconjunctival flap [39]; skin pinch [35]</td>
<td>53</td>
<td>86.1% female</td>
<td>26.5%</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Shao et al. (2014)</td>
<td>30</td>
<td>Transcutaneous lower BLE</td>
<td>50.53</td>
<td>78.7% female</td>
<td>16.7% (1-week post-op)</td>
<td>S.I at 1 w post-op (P&lt;0.01)</td>
<td>N.S (P&gt;0.05)</td>
<td>S.D at 1 w post-op (P&lt;0.01)</td>
<td>N/A</td>
<td>N/A</td>
<td>TMA, TMD, TMH: S.I at 1 w, S.D at 1 mo post-op (all P&lt;0.01); CL, upper angle: S.D at 1 w, 1 mo post-op (all P&lt;0.05)</td>
</tr>
<tr>
<td>Soares et al. (2018)</td>
<td>14</td>
<td>Upper BLE</td>
<td>65.1</td>
<td>86% female</td>
<td>0</td>
<td>N/A</td>
<td>N.S post-op (P&gt;0.05)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Zieto et al. (2020)</td>
<td>53</td>
<td>BЛЕ group: upper BLE; PTO group: combined BLE and MMCR</td>
<td>BЛЕ group: 67.4; PTO group: 64</td>
<td>65% female</td>
<td>N/A</td>
<td>BЛЕ group: N.S post-op (P&gt;0.05); PTO group: S.I post-op (P&lt;0.01)</td>
<td>BЛЕ group: N.S post-op (P&gt;0.05); PTO group: S.I post-op (P&lt;0.05)</td>
<td>BЛЕ group: N.S post-op (P&gt;0.05); PTO group: S.I post-op (P&lt;0.05)</td>
<td>BЛЕ group: N.S post-op (P&gt;0.05); PTO group: S.I post-op (P&lt;0.05)</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Rymar et al. (2017)</td>
<td>58</td>
<td>BЛЕ group: only excision; PTO group: combined BLE and MMCR</td>
<td>BЛЕ group: 60.2; PTO group: 64</td>
<td>96.4% female</td>
<td>0</td>
<td>BЛЕ group: N.S post-op (P&gt;0.05); PTO group: S.D at 90 days, post-op (P&lt;0.01)</td>
<td>BЛЕ group: N.S post-op (P&gt;0.05); PTO group: S.D at 90 days, post-op (P&lt;0.05)</td>
<td>BЛЕ group: N.S post-op (P&gt;0.05); PTO group: N.S post-op (P&lt;0.05)</td>
<td>BЛЕ group: N.S post-op (P&gt;0.05); PTO group: S.I post-op (P&lt;0.05)</td>
<td>N/A</td>
<td>RBS: N.S post-op in the two group (all P&lt;0.05)</td>
</tr>
<tr>
<td>Bautista et al. (2018)</td>
<td>15</td>
<td>PTO surgery; MMCR</td>
<td>62</td>
<td>79% female</td>
<td>0</td>
<td>N.S Post-op (P&gt;0.05)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>LLT: N.S post-op (P=0.05); TO: N.S post-op (P&gt;0.05)</td>
</tr>
<tr>
<td>Wee et al. (2014)</td>
<td>30</td>
<td>PTO surgery; MMCR</td>
<td>55.8</td>
<td>63% female</td>
<td>22%</td>
<td>S.I post-op (P&lt;0.05)</td>
<td>N.S Post-op (P&gt;0.05)</td>
<td>S.D at 1 w post-op (P&lt;0.01) and 2 mo post-op (P&lt;0.05)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Ugbas et al. (2016)</td>
<td>16</td>
<td>PTO surgery; MMCR</td>
<td>51.4</td>
<td>69% female</td>
<td>N/A</td>
<td>N.S post-op (P&lt;0.05)</td>
<td>N.S Post-op (P&lt;0.05)</td>
<td>N.S post-op (P&lt;0.05)</td>
<td>N.S post-op (P&lt;0.05)</td>
<td>RBS, MGD, GCD, SMD, N.S post-op (all P&gt;0.05)</td>
<td></td>
</tr>
<tr>
<td>Watanabe et al. (2014)</td>
<td>59</td>
<td>PTO surgery; levator advancement</td>
<td>66.3</td>
<td>61% female</td>
<td>5.6%</td>
<td>N.S post-op (P&lt;0.05)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>TMR: S.D at 1.5 mo post-op (P&lt;0.001)</td>
</tr>
<tr>
<td>Watanabe et al. (2014)</td>
<td>63</td>
<td>PTO group: combined BLE and MMCR</td>
<td>PTO group: 63.8; BЛЕ group: 68.4</td>
<td>51% female</td>
<td>BЛЕ group: 10.3%</td>
<td>N/S post-op (P&gt;0.05); BЛЕ group: N.S</td>
<td>N/A</td>
<td>N/S post-op (P&gt;0.05); BЛЕ group: N.S</td>
<td>N/A</td>
<td>N/A</td>
<td>TMR: PTO group: S.D at 1.5, 3, 6 mo post-op (all P&lt;0.05); BЛЕ group, N.S post-op (P&gt;0.05)</td>
</tr>
<tr>
<td>Bagheri et al. (2015)</td>
<td>83</td>
<td>PTO surgery levator resection (67.5%); transobturating sling (32.5%)</td>
<td>26.2</td>
<td>44.6% female</td>
<td>78.3%</td>
<td>S.D at 1 and 6 mo post-op (P&gt;0.001)</td>
<td>S.D at 3 and 6 mo post-op (P&lt;0.001)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Gornemann et al. (2012)</td>
<td>17</td>
<td>ER: Hughes flaps (n=16); Cutler-Beard bridge flap (n=1)</td>
<td>69.12</td>
<td>59% female</td>
<td>N/A</td>
<td>N/S post-op (P&gt;0.05)</td>
<td>N/S post-op (P&gt;0.05)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Maximal and minimal OST: N.S post-op (P&gt;0.05); S.D post-op (P&gt;0.05)</td>
</tr>
<tr>
<td>Klein-Theyer et al. (2014)</td>
<td>18</td>
<td>ER: Hughes flap</td>
<td>72</td>
<td>67% female</td>
<td>N/A</td>
<td>S.I in operated eyes (P&lt;0.001)</td>
<td>N.S in operated eyes (P&lt;0.05)</td>
<td>S.I in operated eyes (P&lt;0.031)</td>
<td>N.S in operated eyes (P&lt;0.05)</td>
<td>N/A</td>
<td>MGD, LMA, S.I in operated eyes (all P&lt;0.001)</td>
</tr>
<tr>
<td>Zaky et al. (2016)</td>
<td>11</td>
<td>ER: Hughes flap</td>
<td>67</td>
<td>36% female</td>
<td>N/A</td>
<td>S.D in operated eyes (P&lt;0.05)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

N.S: no significance difference; S.D: significance decrease; S.I: significance increase; Post-op, postoperatively; TMA, tear meniscus area; TMD, tear meniscus depth; TMH, tear meniscus height; TMR, tear meniscus radius; BLE, blepharoplasty; PTO, ptosis; ER, eyelid reconstruction; LLT, lid margin abnormalities; TO, tear osmolarity; RBS, rose bengal scores; MGD, meibomian gland disease; GCD, goblet cell densities; SMD, squamous metaplasia grade; OST, ocular surface temperature; LMA, lid margin abnormalities; mo, months; w, week.
mainly included blepharoplasty, ptosis surgery, and eyelid reconstruction. Of these, 7 (47%) were associated with blepharoplasty, 8 (53%) with ptosis surgery, and 3 (20%) with eyelid reconstruction. Studies were categorized based on types of eyelid surgery.

**Incidence and ocular surface evaluation after blepharoplasty**

As we all know, blepharoplasty can cause postoperative dry eye disease or aggravation of preoperative dry eye complaints. The incidence of dry eye disease after blepharoplasty is 0–26.5% (6,7). DES was more commonly reported following concurrent upper and lower blepharoplasty (31.3%) compared with upper blepharoplasty alone (12.9%) and lower blepharoplasty alone (21.4%). Meanwhile, DES was also more often reported following skin-muscle flap blepharoplasty (29.0%) in contrast to the transconjunctival approach (25.6%) and the transconunjunctival approach with skin pinch (22.9%) (P<0.01). The authors also reported that patients with a preoperative history of DES, eyelid laxity, scleral show, or hormone therapy had a higher risk of developing dry eye after surgery. Dynamic differences were shown in the examination results of the postoperative dry eye disease patients. Shao et al. (8) reported that the OSDI score increased significantly, and the Schirmer test values decreased significantly 1 week postoperatively (P<0.01), but they returned to baseline by 3 months. The tear meniscus height, depth, and cross-section area values increased significantly at 1 week postoperatively, but decreased at 1 month (P<0.01) and returned to baseline at 3 months (P>0.05). Still, no significant differences were shown in perioperative TBUT. However, Rymer et al. (9) mentioned that the blepharoplasty did not affect dry eye scores assessed with a questionnaire. The fluorescein staining scores reduced 30 days postoperatively, with no significant differences (compared to baseline) at 90 days after surgery. No notable differences were found between values of preoperative and postoperative Schirmer, TBUT, or rose bengal staining. The remaining three articles (10-12) evaluated subjective and several objective dry eye parameters, but did not report a considerable effect of blepharoplasty on these parameters.

**Incidence and ocular surface evaluation after ptosis surgery**

Ptosis surgery is one of the most popular procedures in oculoplastic surgery. However, the frequency of dry eye after ptosis surgery is still unclear, and the results reported in different literature are inconsistent. Bagheri et al. (13) reported that 65 (78.3%) patients complained of eye dryness after ptosis surgery (levator resection and frontalis sling). The TBUT significantly decreased 1 and 6 months after ptosis surgery compared with the preoperative results (P<0.001). The Schirmer test with anesthesia had a significant decrease in 6 months after ptosis surgery in comparison to the preoperative results (P=0.02), and the Schirmer test without anesthesia decreased significantly in 1 and 6 months postoperatively (P<0.001). Wée et al. (14) recorded that the incidence of DES was 22%, and the OSDI scores significantly increased postoperatively compared with the preoperative scores (P=0.026). They also found that the results of the Schirmer test were significantly lower after Muller’s muscle conjunctival resection (MMCR) surgery (P<0.001) and at 2-month follow-up (P=0.002) than those before surgery. Watanabe et al. (15,16) mentioned that the incidence of dry eye was 5.6% and 6.9% after blepharoptosis surgery (transcutaneous levator advancement), and the tear meniscus radius significantly decreased at 1.5, 3 and 6 months postoperatively (P<0.05). Zloto et al. (12) examined symptoms changes and dry eye signs after MMCR. They observed a significant increase in fluorescein staining, LG score, and OSDI questionnaire score (P=0.05, P=0.02, and P<0.01, respectively) after surgery. Rymer et al. (9) found no changes for the dry eye test (fluorescein staining, Schirmer test, and TBUT) on 18 patients who underwent MMCR, but a significant reduction in “The Salisbury Eye Evaluation Questionnaire” score (P<0.001). Ugurbas et al. (17) evaluated 16 patients who underwent unilateral MMCR surgery using a dry eye questionnaire, Schirmer test, TBUT, fluorescein, and rose bengal staining. No noticeable difference in all the measured parameters between the operated eyes and the controlled eyes. Bautista et al. (18) observed changes in objective and subjective dry eye tests preoperatively and 3 months postoperatively in 14 patients who underwent MMCR. They revealed no significant difference in the TBUT, lipid layer thickness, and osmolarity. The differences in these results may be attributed to the patient number among studies (18 in Rymer et al.; 30 in Wée et al., and 31 in Zloto et al.). These studies have also found that MMCR surgery increased the subjective sensation of dry eye and dry eye signs in various clinical tests.

**Incidence and ocular surface evaluation after eyelid reconstruction**

Eyelid reconstruction is widely used for managing full-
thickness eyelid defects. When the defect is more than 50% of the eyelids’ horizontal length, the Hughes or Cutler-Beard bridge flaps (19,20) usually suitable for reconstruction of eyelid defects. Wang et al. (21) revealed that the McMonnies dry eye score significantly increased in the operated eyes than the fellow eyes. The operated eyes displayed inferior lipid layer quality, non-invasive tear film stability, and tear film evaporation than unoperated fellow eyes (all P<0.05). The exposed ocular surface areas, upper and lower eyelid percentages, meibomian gland dropouts, and sodium fluorescein staining scores were higher in operated eyes (all P<0.01). Klein et al. (22) evaluated ocular surface characteristics and tear film functions in 18 patients following modified Hughes flap for eyelid reconstruction. They reported a significant loss of meibomian glands (P<0.001) and more lid margin abnormalities in the upper and lower eyelids (P<0.001), as well as increased fluorescein staining of the cornea on the operated sides (P=0.031) compared with the unoperated sides. Nevertheless, Schirmer test, OSDI, BUT, tear film osmolarity, LG staining, and the lipid layer interferometry (Tearscope) were compared between both sides, and the differences were not statistically significant. Zaky et al. (23) found a significant decrease of BUT in the eyes with a modified Hughes procedure compare to the value in the contralateral eyes, which indicates tear film instability. Gonnermann et al. (24) found no significant difference in Schirmer test, break-up time, and ocular surface temperature between 17 patients after full-thickness eyelid reconstruction and a control group.

**Discussion**

This comprehensive literature review found that the eyelid surgeries associated with dry eye disease mainly involve blepharoplasty, ptosis surgery, and eyelid reconstruction. Given the differences in the current study results, it is not yet clear whether patients who received eyelid surgery have an increased risk of dry eye disease. Dry eye disease is a multifactorial disease, and some risk factors might lead to dry eye disease after eyelid surgery. Hamawy et al. (6) divided the risk factors into systemic diseases, drugs, environmental factors, and anatomical factors (Table 2). These factors seem not to be an absolute contraindication to eyelid surgery, but early detection will help prevent or reduce dry eye disease incidence.

**Mechanism of dry eye after eyelid surgery**

The mechanism of normal tear physiology mainly includes: tear production and release from the lacrimal and accessory glands, tear blinking and distribution, and tear pumping...
into the tear drainage system (25). Blepharoplasty has become the second most common plastic surgery in the United States. It is a surgical procedure that improves the aesthetic appearance of the eyelids. Upper eyelid blepharoplasty is the gold-standard surgery for correcting dermatochalasis. It commonly involves the excision of skin, preseptal orbicularis oculi muscle, and orbital fat. Lower eyelid blepharoplasty’s primary surgical approaches include the skin-muscle flap, the skin flap, and the transconjunctival procedure. Blepharoplasty changes the close interaction between the eyelids, the tear film, and the ocular surface, thereby affecting the tear film (26). Operational changes to the anatomy of the eyelid can affect eyelid closure and blink. Standard blepharoplasty involves the removal of both the skin and a portion of the underlying orbicularis oculi muscle. However, the orbicularis oculi muscle excision may lead to a decreased blink rate, incomplete reflex blink, and lagophthalmos. These could eventually result in increased tear evaporation, reduced tear film distribution and tear drainage with impaired debris removal from the ocular surface.

The degree of eyelid droopiness and the preoperative levator function determine which surgical method will be adopted. There are three types of ptosis surgery: transcutaneous (27), transconjunctival (28) and sling surgery (29). In the conjunctival approach, damage to goblet cells and accessory lacrimal glands may affect the quality or quantity of tears (12,14). The transcutaneous approach mechanisms may include bending of the lacrimal canal, particularly which originates from the palpebral lobe, postoperative inflammation, changes of tear flow, widened palpebral fissure, increased tear evaporation, and changed sensitivity of the cornea and conjunctiva (30). Hughes transconjunctival flap procedure involves a meibomian glands loss, which is not only in the lower eyelid due to the tumor excision but also in the upper eyelid transconjunctival flap. Lack of meibomian glands causes insufficient lipid secretion, which leads to instability of the tear film. Moreover, the surgery can also change the eyelids and cornea's relative position, thus mechanically changing the corneoscleral and conjunctival interface, aggravating dry eye disease (24).

Whether the patients underwent blepharoplasty, ptosis surgery, or eyelid reconstruction, they all have the possibility of causing or aggravating dry eye after operation. Therefore, surgeons should pay attention to perioperative evaluation, surgical operation, and postoperative care to effectively reduce dry eye symptoms.

**Preoperative evaluation**

Before surgery, surgeons should make full communication with patients, such as asking the patient for dry eye symptoms and examining signs of dry eye disease to assess the risk factors for dry eye disease, such as systemic diseases, medications, etc. Ensure the patient did not have an eye surgery recently, if any, it is recommended to postpone the operation for 6–12 months (6). Verify whether patients have a habit of prolonged reading (31), driving, watching electronics, smoking (32), wearing contact lenses (26), and other behaviors that exacerbate dry eye disease. Doctors need to know whether female patients are in their menopause, taking oral contraceptives, or receiving hormone replacement therapy (33,34). Preoperative physical examination should confirm if the patient has morphological risk factors, such as proptosis, lower lid laxity, scleral show, negative vector orbit, and lateral canthal dystopia (35,36).

Furthermore, doctors should record signs of dry eye disease such as epiphora, erythema, eye fatigue, and increased blink rate before surgery. Schirmer test with anesthesia may also be performed before surgery (26). For patients with dry eye disease or dry eye risk factors, surgeons should carefully decide whether to operate according to the degree of symptoms and risks.

**Surgical operation**

(I) Corneal protection is an essential but often overlooked aspect of the surgery. Trauma or prolonged exposure can lead to corneal bruising or ulcers, one of the leading causes of dry eye disease after surgery. The use of lubricants and corneal protectors is crucial to protect the eyes (37).

(II) Follow the principle of conservative skin excision during the operation. When operating on the upper lid, leave 8–9 mm skin in the pretarsal fold using a caliper, and the upper skin from the lower margin of the brow to the lid margin must be retained at least 20 mm (38). Since postoperative healing and scarring may cause lower lid retraction and ectropion, it is necessary to consider conservative skin excision during lower eyelid surgery. Generally, lagophthalmos do not occur after surgery, even if edema should be less than 2 mm (6).

(III) When upper and lower eyelid surgery is required, performing upper and lower blepharoplasty in stages
might reduce the incidence of postoperative dry eye disease (7).

(IV) Avoid aggressive resection of the orbicularis oculi muscle and injury to the innervation, as the operations may result in decreased blink rates and increased loss of tear evaporation (39,40). Kiang et al. (41) found that muscle-sparing upper blepharoplasty produced similar aesthetic outcomes as conventional blepharoplasty, while significantly reducing dry eye disease complications.

(V) Previous studies have found that control of inflammation can reduce postoperative chemosis (42), closely related to dry eye diseases (6). Minimizing dissection, trauma, and denervation can reduce the occurrence of inflammation and chemosis (43). Furthermore, preoperative intravenous injections of dexamethasone can also limit the inflammatory response (44). Other measures taken to preventing chemosis-caused “exposure” include frequent lubrication, temporary tarsorrhaphies, and postoperative Frost-type (traction) sutures.

(VI) Canthopexy can correct the lateral canthal depression and lessen the risk of ectropion. The canthoplasty should correct severe lower eyelid laxity before surgery (6).

(VII) Depending on the patient's lower eyelid morphology, concurrent midface-lifting, or fat augmentation can prevent the lower eyelids’ complications and further reduce the likelihood of dry eye disease (45). Lower eyelid malposition, such as retraction or ectropion, may lead to DES, and thus it is essential to examine the position of the lower eyelid before surgery. It is recommended for patients with both ptosis and lower lid malposition to have lower lid surgery first and then MMCR surgery.

(VIII) In eyelid reconstruction, the flap's shrinkage and contraction may affect the lower eyelid function and lead to eye exposure and irritation. It is recommended to leave a more substantial portion covering 2–3 mm of the lower part of the cornea on the flap division (23).

(IX) Do not damage the lacrimal gland, and avoid mistaking it with fat during the surgery (46,47). Literature (47) reported that about 60% of patients undergoing blepharoplasty had lacrimal gland prolapse, especially those who experienced multiple eyelid surgeries. As the lacrimal gland prolapsed, we advocated resuspending it to the periosteum along the superolateral orbital rim's inner aspect (38).

Postoperative care.

Limiting edema, taking lubrication, controlling inflammation, and preventing infection (6,48) are the objectives of postoperative prevention of dry eye. Postoperative edema may be controlled with head elevation and periorbital cold compresses (49). It will take several days for the normal tear membrane to recover due to the damage by surgery. Therefore, it is necessary to administrate artificial tears during the day and eye ointment for lubrication at night. Local antibiotics and steroid drops can be applied to prevent inflammation and conjunctivitis (50).

If dry eye symptoms persist for more than 2 weeks, patients need to evaluate the potential causes. When chemosis is not present, continue to lubricate the eyes and use corticosteroids. For symptoms lasting more than 3 months, consider tear duct occlusion to reduce the flow of tears and maintain eye lubrication (51). If this result from overzealous resection of eyelid skin during surgery, skin grafts may be required (52). When symptoms continue to persist or worsen, consider whether it is related to eyelid malposition. Moreover, if so, it can be corrected by canthoplasty or reduction (50,53). If chemosis persists, it is recommended to using hydration, lubrication, topical or oral steroids, and diuretics. It is also useful to use topical cyclosporin A 0.05% twice per day and temporary eyelid suture (6).

Conclusions

The risk of developing dry eye disease may increase after eyelid surgeries (blepharoplasty, ptosis surgery, and eyelid reconstruction). Only a few studies have reported dry eye disease after limited eyelid surgery. Comparing of the effect of different surgical approaches on the ocular surface and tear film needs further research. Moreover, the ocular surface evaluation methods in the previous studies mainly focused on the Schirmer test, TBUT, and other traditional examinations. We suggested that the latest detection methods should be used to investigate the etiology of postoperative dry eye disease in the future. During the consultation and preoperative evaluation, the surgeon must discuss the patient potential risk factors that may lead to symptomatic dry eye disease. Preoperative assessment of risk factors, intraoperative and postoperative management, and appropriate surgical methods can reduce dry eye disease incidence after eyelid surgery. For this reason, we advised using an algorithm (Figure 2) perioperatively, which
may help to reduce the incidence of chronic DES. The algorithm can improve our overall understanding of DES, select the best surgical method, improve patient compliance, and ultimately improve the prognosis.

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**Footnote**

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References

do: 10.21037/aes-20-98
Appendix 1

PubMed: (((((((((((Dry Eye Syndrome[Title/Abstract]) OR Dry Eye Disease[Title/Abstract]) OR Dry Eye Diseases[Title/Abstract]) OR Dry Eye[Title/Abstract]) OR Dry Eyes[Title/Abstract]) OR Evaporative Dry Eye Disease[Title/Abstract]) OR Evaporative Dry Eye Syndrome[Title/Abstract]) OR Evaporative Dry Eye[Title/Abstract]) OR Dry Eye, Evaporative[Title/Abstract]) OR Evaporative Dry Eyes[Title/Abstract]) OR "Dry Eye Syndromes"[Mesh])) AND (((Surgery, General[Title/Abstract]) OR Surgery[Title/Abstract]) OR "General Surgery"[Mesh])) AND ((Eyelid[Title/Abstract]) OR "Eyelids"[Mesh])))