BRIEF COMMUNICATIONS

Tear Lipid Layer Interference Changes After Dacryocystorhinostomy

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Purpose: Specular images of the tear film in the central cornea were examined in patients with nasolacrimal duct obstruction to observe changes before and after dacryocystorhinostomy (DCR).

Methods: We observed the specular images in 4 patients (5 eyes) by a noncontact observation device and recording system. Observed patterns were classified into five grades. The specular images and tear meniscus height (TMH) were recorded.

Results: Three of the 4 eyes with TMH values over 0.4 mm before DCR showed decreased TMH postoperatively. The 1 eye with a TMH value of 0.2 mm showed no change after DCR. Using specular images, 4 eyes were classified grade 1 or 2, and 1 eye was classified grade 4 before DCR. After DCR, the 5 eyes were classified grade 3 or grade 4.

Conclusion: The results indicated that the eye after DCR has a thicker lipid layer than the eye before DCR. Jpn J Ophthalmol 2001;45:653–656 © 2001 Japanese Ophthalmological Society

Key Words: Dacryocystorhinostomy, nasolacrimal duct obstruction, tear film lipid interference patterns, tear film lipid layers.

Introduction

Dacryocystorhinostomy (DCR) is an effective surgical treatment for patients with obstruction of the nasolacrimal duct (NLD) associated with persistent epiphora. Modified surgical methods and a success rate of about 90% (85–94%) have been reported. However, less attention has been paid to changes in the quality of the tear film after DCR. Various methods have been suggested to eliminate the sensation of epiphora, such as lacrimal sac irrigation with physiological salt solution to examine the obstruction of the NLD, and the slit-lamp observation of tear meniscus height (TMH) before and after DCR. To our knowledge, however, few previous reports have described changes in the quality of the tear film after DCR.

There have been many reports on the examination of the quality of the tear film in patients with dry eye, especially the lipid layer and interference patterns in the lipid layer. Recently, Yokoi et al. have developed a device to observe specular images of the tear film in the center of the cornea without contacting the surface of the tear film. They reported that tear lipid layer interference patterns had a strong correlation with the severity of dry eye. The specular reflection patterns of the superficial lipid layer can be visualized and classified according to the thickness of the lipid layer in the normal eye and dry eye. The precise quality of the precorneal tear film, particularly the superficial lipid layer covering the ocular surface after DCR, is not fully understood. We
could not find any previous reports in the literature concerning changes in the specular images of the tear film after DCR.

In this study, using a system for grading tear film lipid interference patterns, we prospectively evaluated the tear film surface of patients with NLD obstruction who complained of persistent epiphora before and after DCR.

Materials and Methods

Five eyes of 4 female patients (average age ± SD = 71.4 ± 8.8 years) were treated by DCR and were followed up at our clinic. All the patients complained of epiphora and were eager to be treated by surgery. Before surgery, the diagnosis of NLD obstruction was confirmed in all patients by irrigation of the duct. Ocular examinations, including Schirmer I test, observation of TMH, and observation of precorneal tear lipid layer interference patterns in the central cornea were performed before and one month after DCR with DR-1 (Kowa, Tokyo). Observed patterns of tear lipid layer interference were classified into five grades, according to the system reported by Yokoi et al. Measurements of TMH were determined by reading from a reticule that was inserted into a slit-lamp microscope.

This device, originally described by Yokoi et al., enables observation of specular reflected light from the tear surface. The specular reflected light returns to a charge-coupled video camera that produces a live image on a television monitor. Each image was recorded on videotape for 30 seconds, during which time the subjects were allowed to blink naturally. A representative image from each recording was printed out using a color video printer. Each representative image was classified into one of five grades.

Quantification of tear film lipid layer thickness could be performed by observation of the color interference patterns in zones of specular reflection. The thickness values were derived by correlating the dominant color of the pattern with the corresponding values from previous examination. Grey indicates a very thin lipid layer (<60 nm), yellow indicates a thin lipid layer (90–120 nm), brown indicates a thicker lipid layer (135–150 nm), and blue indicates the thickest lipid layer (165–180 nm). Figures 1A, B show gray color distribution, and Figures 1C, D show many colors, of which yellow and red are dominant.

Surgical Technique

All procedures were performed under local anesthesia, and all patients were operated on by either one of two surgeons (MK or YA). An incision 1.5 cm in length was made over the anterior lacrimal crest. Next, silicone tubes were inserted and left in place for 1 month. The osteotomy was made as large as possible. It included the anterior lacrimal crest and extended to the posterior lacrimal crest. A cotton pledget inserted into the nasal cavity was removed 1 week after surgery.

Results

After DCR, symptoms of tearing disappeared in all patients. The passage of NLD remained open in all except patient 1. Patient 1 showed stenosis of part of the rhinostomy at 30 days and re-obstruction at 45 days after DCR, although she did not complain of epiphora. The conditions of the tear fluid before and after DCR in all patients are shown in Table 1.

In 3 eyes of patients 2 and 3, TMH values changed from over 0.4 mm to under 0.2 mm after surgery. The TMH value in patient 1 changed from 1.0 to 0.4 mm. The operated eye in patient 4 showed no change in TMH values after DCR.

Before DCR, the tear film lipid layer interference patterns in 4 eyes were classified as grade 1 or 2, and 1 eye was grade 4. After DCR, 2 eyes were grade 3, and 3 eyes were grade 4 (Table 1). Although the operated eye of patient 4 showed no change in the tear film lipid layer interference patterns after DCR, the other 4 eyes had a higher grade after DCR than before DCR.

A representative case is presented in the following case report.

Case Report

Patient 3 (Figure 1) was a 77-year-old woman who suffered from bilateral chronic dacryocystitis for 4 years. Obstruction of the NLD in both eyes was confirmed by an irrigation test. Schirmer I test showed wetting measuring 8 mm OD and 6 mm OS. In both eyes, the TMH was 0.4 mm. The tear film lipid layer before DCR was graded 2 in both eyes. A successful DCR was performed bilaterally, initially in the left eye and, two weeks later, in the right eye. TMH was 0.1 mm, and the tear film lipid layer changed from grade 2 to grade 4 in both eyes on examination one month after DCR. Schirmer I test showed wetting 3 mm OD and 0 mm OS. An irrigation test result was good and the patient had no complaints of tearing or dry eyes. There was no ocular surface staining by fluorescein in either eye.

Discussion

The results of the pre-DCR investigation demonstrated that patients with TMH values over 0.4 mm
showed specular images of tear film with a very thin lipid layer as grade 1 or grade 2. The reason the lipid layer tended to be thinner before DCR was because there was much tear liquid due to NLD obstruction and the lipid layer could stretch over the whole area of the cornea. After DCR, the specular images of the tear film changed to grade 3 or grade 4 with a decrease in TMH, which indicates there was thickening of the lipid after DCR. Although the exact reason why the lipid layer became thick after DCR is uncertain, we have considered the following possibilities. First, the tear flow improved to a normal condition after DCR and the volume of tears was reduced because of the patient’s age. The lipid layer could not be extended on the corneal surface and became thicker and more irregular than it had been pre-DCR. Second, the spreading mechanism for the tears could not operate because of less volume of tears on the cornea. It was reported that there was an aqueous reduction in the aqueous-deficient patients, and consequent reduction in the forward displacement of lid secretory lubricant because the tear film was compressed during blinking. In fact, we could observe a blue line which indicates a thicker lipid layer above the inferior lid in the post-op right eye of case 3 (Figure 1C).

Case 1, who had complete obstruction of the NLD and showed grade 1 of TMH, 1.0 preoperatively, showed severe stenosis in the irrigation test 30 days after DCR. This same case, in whom re-obstruction occurred at 45 days after DCR, therefore, must have had a low passage of tears. Schirmer I test showed wetting measuring 35 mm OD at this time. However, case 1 showed grade 2 in the specular images of the tear film of both eyes after complete re-obstruction of the NLD 45 days after DCR. Possible reasons why

Figure 1. Change in tear film lipid layer interference patterns in patient 3. (A) Right eye before dacryocystorhinostomy (DCR), diagnosed grade 2. (B) Same eye after DCR, diagnosed grade 4. Note blue line above inferior lid (arrow). (C) Left eye before DCR, diagnosed grade 2. (D) Left eye after DCR, diagnosed grade 4.
case 1 showed grade 3 at 30 days after DCR may be that the interpalpebral opening was narrow or that the eye had a thicker lipid layer because the patient rubbed her eyelid.²

In a previous study,² it was reported that grade 3 or 4 eyes corresponded to dry eye, but these 4 patients did not complain about dry eye and did not show ocular surface staining by fluorescein. Although the flow rate in classical Sjögren syndrome in these cases was reported to be low, drainage of tear fluid into the nasal cavity postoperatively might have made the flow rate normal. We consider that mainly the difference in flow rate brought about these results in our cases. The other possible factors were thought to be the osmolarity, the rate of evaporation, the available volume of tears in the preocular pool and the viscosity of the lid layer.³ These factors might have had an effect on the cornea. The present study alone does not clarify the differences between these cases after DCR and the dry eye or classical Sjögren syndrome.

The present study clearly showed that the specular images changed to a higher grade after DCR, and that this change in the lipid layer was accompanied by an improvement in the symptoms of epiphora. This leads us to suggest that the specular image is a valuable additional method for evaluating lipid layer changes before and after DCR, and that we should be careful to examine patients for dry eye after DCR.

To evaluate postoperative tear fluid clearance, we need to examine specular images in a broad age group before and after DCR and compare these cases after DCR and cases with cases of dry eye or classical Sjögren syndrome.

This work was presented in part at the meeting of the International Society for Orbital Disorders, Uraybandai, Fukushima, Japan, in May 19–21, 2000.


References

Table 1. Change in Tear Fluid After Dacryocystorhinostomy (DCR)

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Age (yr)/Sex</th>
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*NLD: nasolacrimal duct.
†NE: not examined.
‡TMH: tear meniscus height.