Exploring the Predisposition of the Asian Eye to Development of Dry Eye

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ABSTRACT **Purpose: To investigate the influence of eyelid shape on tear film quality, ocular surface characteristics and dry eye symptomatology by comparing Asian and Caucasian populations. Methods: Seventy-four age-matched participants were recruited in a cross-sectional study. Participants were classified into Asian single lid (ASL), Asian double lid (ADL), and Caucasian double lid (CDL) groups. Dry eye symptomatology, ocular surface characteristics, and tear film quality were evaluated in a single clinical session. Results: Meibomian gland dropout was significantly greater in both the ASL and ADL groups than in the CDL group (all $P<.05$). A greater proportion of ASL and ADL participants exhibited incomplete blinking than CDL patients (all $P<.05$). There were no significant differences in tear film quality and dry eye symptomatology between the three groups (all $P>.05$). Exposed ocular surface area, lissamine green staining, and lid wiper epitheliopathy were significantly greater in the ADL group compared to the CDL group (all $P<.05$). The CDL group displayed significantly greater anterior blepharitis and lid telangiectasia grades compared to both ASL and ADL groups (all $P<.05$). Conclusions: A higher degree of meibomian gland dropout and incomplete blinking was observed in both Asian groups compared to the Caucasian group, potentially predisposing these groups to dry eye.**

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I. INTRODUCTION

Dry eye is a multifactorial disease of the tear film and ocular surface, which has an adverse impact on comfort, vision, and quality of life.[1] A higher prevalence and severity of dry eye has been reported in Asian populations compared to Caucasian populations[2-6] for reasons that are not fully understood. Poorer tear film stability and greater corneal desiccation have been described in the Asian eye,[7,8] as well as more marked meibomian gland dysfunction (MGD).[9]

The eyelids have an important role in the maintenance of a healthy tear film and ocular surface.[10-13] They protect the tear film from extrinsic factors, including wind and debris.[12] The eyelid houses meibomian glands and accessory secretory glands, which are essential for healthy tear film composition. The blinking mechanism stimulates lipid secretion and facilitates the distribution of the tear film over the ocular surface.[11,14]

Eyelid shape and anatomy differ between Asian and Caucasian eyes.[15-17] The eyelid can be classified as a single or double eyelid, depending on the presence of the superior palpebral crease, which is determined by the position of the dermal attachment of the *levator palpebral superioris* aponeurosis.[15-17] In the Caucasian eye, the levator aponeurosis pierces the orbital septum at a higher point, allowing attachments of its fibers to the subcutaneous tissue to create the superior palpebral crease. In contrast, this crease is absent in 40-60% of Asian eyes[15] due to a lower aponeurosis fibrous attachment position.

The relative contribution to dry eye symptoms arising from the eyelid shape is not known. This cross-sectional, observational study seeks to compare tear film quality, ocular surface characteristics, and dry symptomatology in participants with different eyelid features.

II. MATERIAL AND METHODS

A. Subjects

The study followed the tenets of the Declaration of Helsinki and was approved by the institutional Human Participants Ethics Committee. To minimize environmental

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differences, participants were required to be New Zealand-born residents; of East Asian or Caucasian descent; between 18 and 40 years of age; with no contact lens use 48 hours before study participation; no ocular infection or corneal disease; no history of ocular surgery; no topical or systemic medications, or conditions affecting the eye. Participants of mixed or South Asian descent were excluded. Eligible participants were enrolled after providing written informed consent. Participants were then subdivided into three groups: Asian single eyelid (**ASL**), Asian double eyelid (**ADL**), and Caucasian double eyelid (**CDL**), according to ethnicity and the presence or absence of the superior palpebral crease in the open eye state (Figure 1).

A total of 74 eligible participants were recruited into age-matched groups comprised of 23 ASL, 28 ADL and 23 CDL participants. This exceeded the sample size requirement for the desired study power. The designated outcome measure for determining sample size was meibomian gland function as determined by tear film lipid layer grade. Power calculations showed that a minimum of 17 subjects was required for each group to detect a clinically significant difference of 1 lipid layer grade in any of the pairwise comparisons, with 80% power (β=0.2), and at a two-sided statistical significance level of 5% (α=0.05). The SD of normal values was estimated at 1 lipid layer grade. Sample size estimates were determined using a uniform non-parametric adjustment, with PASS 2002 (NCSS Statistical Software LLC, Utah, USA).

B. General Evaluation

Dry eye symptomatology, ocular surface characteristics and tear film quality were evaluated in a single clinical session for the right eye of each participant. The tests were conducted in ascending order of invasiveness to minimize the impact on tear film physiology for subsequent tests. All subjects were assessed in the same location, with a mean ± SD room temperature of 21.9 ± 0.5°C and a mean ± SD relative humidity of 49.2 ±6.5%.

The McMonnies and Ocular Surface Disease Index (**OSDI**) questionnaires were administered to grade the level of dry eye symptomatology. A McMonnies cut-off score of ≥14.5,[18] and OSDI score of ≥12,[19] were used to identify participants with symptomatic dry eye. Blink rate was recorded as the number of complete and incomplete blinks made during a 1-minute interval. The presence or absence of incomplete blinking was noted. These measurements were taken while the participant was unaware to prevent interference with the natural blinking pattern of the participant.

A high-resolution digital image of the palpebral aperture was taken with a small graticule ruler placed in the same plane, adjacent to the eye. The image was then calibrated and analyzed on Image J software (National Institutes of Health, MD, USA) to calculate the vertical and horizontal palpebral aperture size and total exposed ocular surface. The best spectacle-corrected logMAR visual acuity was recorded and the refractive error measured with the Auto Kerato-Refractometer KR-8100 (Topcon, Tokyo, Japan) reported as mean spherical equivalent and astigmatic vectors, J_0 and J_{45}. Vector analysis enabled subsequent astigmatic comparison to be made between groups.[20] Corneal curvature and eccentricity were mapped using the Keratograph 5M (Oculus, Wetzlar, Germany). The steepest axis was categorized as either 'with-the-rule' astigmatism (within 30° of horizontal); 'against-the-rule' astigmatism (within 30° of vertical); or 'oblique' astigmatism (the remainder).

C. Tear Film Evaluation

Tear film lipid layer grade and noninvasive tear film breakup time (**NIBUT**) were assessed using the Tearscope Plus (Keeler, Berkshire, UK), with fine grid insert for NIBUT

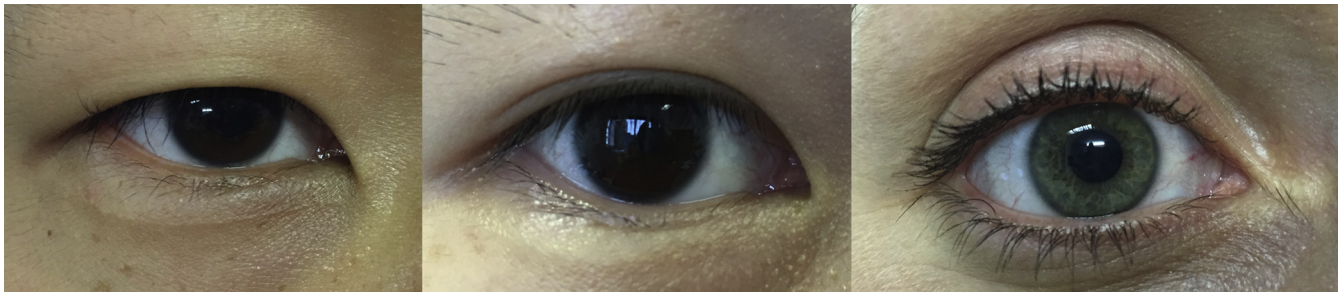

Figure 1. Typical variations in eyelid shape. Left image shows an ASL with the absence of a lid crease. Middle image shows an ADL with lid crease. Right image shows a CDL with lid crease.