The Ocular Surface xxx (2018) 1–5

Contents lists available at ScienceDirect

The Ocular Surface

journal homepage: www.theocularsurface.com

Original Research

The significance of meibomian gland changes in asymptomatic children☆

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ARTICLE INFO

Article history:
Received 9 November 2017
Received in revised form
28 February 2018
Accepted 20 March 2018

ABSTRACT

Purpose: To evaluate meibomian gland morphology and function in children without ocular discomfort.
Method: A total of 266 eyes of 266 children without signs or symptoms of ocular surface dysfunction were enrolled. Morphology of meibomian glands (MG) and non-invasive break-up time (BUT) was assessed by noncontact meibography. Based on lipid layer thickness (LLT) of the tear film measurements, 66 children were chosen to be assessed by meibomian glands yielding liquid secretion (MGYLS).
Results: Based on the presence of physiologic conjunctival follicles (PCF), participants were divided into normal or PCF groups. The distortion and deficiency of MG function was significantly higher in PCF group ($P = 0.002$, 0.007, respectively). Five different gland duct shapes (vertical, tortuous, overriding, hooked, U-shaped) were observed. MG deficiency was positively correlated with age ($R = 0.362$, $P < 0.001$). Distortion and the number of MG showed no correlation with age ($P > 0.05$). However, distortion and deficiency of MG were negatively correlated with LLT ($P < 0.001$, $P < 0.01$).
Conclusion: Children with PCF had significantly more MG distortion and deficiency which was associated with LLT. These results prompt future studies to determine if changes in MG morphology are congenital or acquired.

1. Introduction

Meibomian gland dysfunction (MGD), a chronic, diffuse abnormality of meibomian glands (MG), is commonly characterized by terminal duct obstruction and/or qualitative/quantitative changes in the glandular secretion [1], which is a contributing cause of dry eye disease [2]. MG dysfunction may result in alteration of the tear film causing symptoms of eye irritation, clinically apparent inflammation, and ocular surface disease [3].

Abnormal MG morphology has been the focus of many studies in recent years. A grading system of meibomian gland atrophy, based on assessment of MG dropout, has been proposed and applied in clinical practice [3–6]. Several studies have examined MG distortion. For example, Arita, R et al. observed single meibomian gland duct distortion in both normal and allergic conjunctivitis adult patients [7]. Furthermore, they reported that allergic reactions caused by contact lens wear increased the distortion of meibomian glands [8]. Pult, H et al. demonstrated that the angle of MG distortion with angles over 45° was significantly correlated with changes in lipid production [4]. However, no studies have described MG distortion in children.

Studies on MG dysfunction have primarily focused on adults [9,10]. Mizoguchi, T et al [11] report changes in MG morphology and function in junior high school aged children. The population they chosen are adolescents with good cooperation. Questionnaires combined with clinical assessment are often effective tools in the diagnosis of MGD, however the usefulness of these tools is limited in children who are developing communication skills [12]. For this reason ocular surface disease in children is often not correctly diagnosed by clinicians [13]. Additionally, increased use of electronics by children has led to an increase in MGD-related dry eye [14]. Clinicians often diagnose dry eye syndrome in children based solely on signs and symptoms. As a result, many of the clinical and epidemiological aspects of MG dysfunction in children have not be described. By contrast, assessment of MG morphology is a relatively stable and objective evaluation of MGD severity. In this study, we

☆ The authors have no commercial or proprietary interest in any concept or product described in this article.

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https://doi.org/10.1016/j.jtos.2018.03.006
1542-0124/

report that children without signs and symptoms have morphological MG changes which may be an important diagnostic to tool for MGD assessment in children. Overall, the purpose of the study is to understand changes of meibomian gland morphology in children without any reported symptoms.

2. Patients and methods

This cross-sectional study was performed at the Eye Hospital of Wenzhou Medical University at Hangzhou, Zhejiang, China. The study was approved by the Institutional Review Board/ Ethics Committee of Wenzhou Medical University. Informed consent to participate in this research study was obtained from children with age less than 14 years without complain about ocular surface discomfort. Practices and research protocols were conducted in accordance with the tenets of the Declaration of Helsinki.

Exclusion criteria included blepharitis, ocular allergies, obvious eyelid or ocular surface disorders, contact lens wear, continuous eye drop use, a history of eye surgery, or systemic or ocular diseases that would interfere with tear film production or function. Data used in this study were obtained from the right eye of each subject.

A total of 266 eyes in 266 children were enrolled in this cross-sectional clinical study. The subjects included 117 males and 149 females with a mean age of 10.76 ± 1.76 years (range 7–14 years). The age distribution of patients is found in Fig. 1.

The temperature and humidity of the examination room were maintained between 20 °C to 25 °C and between 40% to 60%, respectively, during examinations.

All of the Lipid layer thickness (LLT) and partial blink (PB) were measured by Lipiview Interferometer (Tear Science Inc. Morrisville, NC).

Meibography was performed using a Noncontact Meibography System (Kerotography 5 M, Oculus, Wetzlar, Germany). Meibomian gland deficiency was calculated using ImageJ software and was defined as the proportion of the area of meibomian gland in its relation to the total area of the upper tarsus [15]. Subsequently, the presence of distortion was determined by the angle of meibomian gland. The number of meibomian glands was calculated using images of MGs.

The value of tear meniscus height (TNH) and non-invasive keratographic break-up time (NIKBUT) was captured by Keratography 5 M, as previously described [16,17].

66 subjects were randomly chosen for evaluation of MG function. The number of meibomian gland orifices were quantified using the Meibomian Gland Evaluator (TearScience Inc.). Using this handheld instrument, defined pressure (a consistent force of 1.25 g/mm^2, similar to that experienced with a deliberate or forced blink) was applied to the nasal, central, and temporal regions of the lower eyelid. Each region contained five consecutive meibomian gland orifices. A total of 15 glands were evaluated along the lower eyelid margin. Additionally, the number of meibomian glands yielding liquid secretion (MGYLS) and meibomian glands yielding clear secretion (MGYCS) was determined. The lid margin was evaluated with scores from 0 through 4 according to irregular lid margin, vascular engorgement, and anterior or posterior replacement of the mucocutaneous junction [6].

Statistical analysis was performed using SPSS19.0. All data are presented as means ± standard deviation (SD). Statistical differences between the two groups were determined using independent t-tests. The relationship between parameters were assessed by the linear Pearson's correlation coefficient and Spearman tests, respectively.

3. Results

3.1. Morphology of meibomian glands

3.1.1. Distinct shapes of MGs

Fig. 2 shows five distinct shapes of glandular ducts observed in children: 1) Vertical - the MG duct was straight; 2) Tortuous - a single glandular duct was bent into a defined angle; 3) Overriding - a single glandular duct crosses one or more adjacent ducts; 4) Hooked - the proximal part of duct had a slight bend, like a hook; 5) U-shaped - the ends of two glandular ducts connect like "U".

3.1.2. Distortion of MGs

Furthermore, we quantitatively defined changes in MG distortion. Meibomian gland distortion was clinically scored as follows: grade 0: no distortion; grade 1: distortion >90°, area <1/3; grade 2: distortion >90°, area: 1/3–2/3; distortion: 45–90°, area <1/3; grade 3: distortion >90°, area: > 2/3; distortion: 45–90°, area: 1/3–2/3; grade 4: distortion:45–90°, area: >2/3; distortion:45°, area: <50%; grade 5: distortion <45°, area: > 50% (Fig. 3).

3.2. A comparison between asymptomatic patients with physiologic conjunctival follicles and without

A total of 266 asymptomatic children were enrolled in this study. Based on the presence of physiologic conjunctival follicles

Fig. 1. Age distribution of children enrolled in the study.

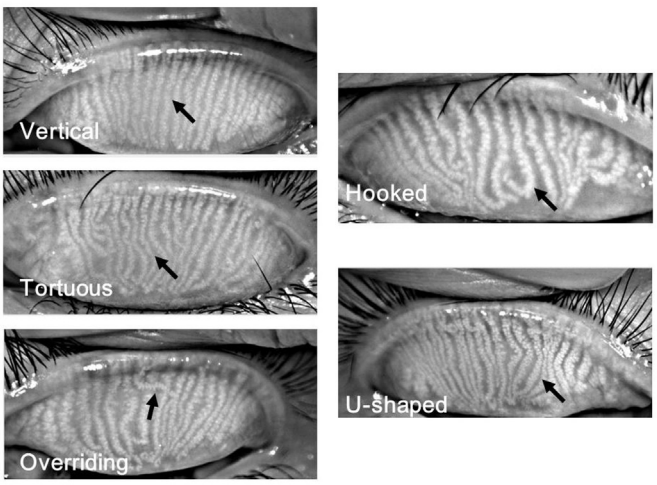

Fig. 2. Five distinct morphological shapes of the MG duct.

Please cite this article in press as: Zhao Y, et al., The significance of meibomian gland changes in asymptomatic children, The Ocular Surface (2018), https://doi.org/10.1016/j.jtos.2018.03.006