Contact Lens & Anterior Eye 35 (2012) 77–80

Contents lists available at SciVerse ScienceDirect

Contact Lens & Anterior Eye

journal homepage: www.elsevier.com/locate/clae

Non-contact meibography: Keep it simple but effective

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ARTICLE INFO

Keywords:
Meibomian Gland Dysfunction
Meibography
Lipid layer
Tearfilm stability
Dry eye

ABSTRACT

Purpose: Meibography is reported to be important in Meibomian Gland Dysfunction (MGD) evaluation. Our purpose was to investigate the usefulness of a standard infra-red video security camera in meibography.
Methods: Meibographs were taken of the right lower lid of 17 subjects (female 10; age = 44.3 years ±13.3 SD), randomly selected from the patient pool of Horst Riede GmbH, Weinheim, Germany. Meibomian glands (MG) were photographed by an near adapted infra-red video security camera and extend of MG loss (MGL) was measured by digital image analyzes. Lipid-layer and non-invasive break-up time (NIBUT) was measured by tearscope, dry eye symptoms were evaluated by the Ocular Surface Disease Index (OSDI). Correlations between MGL scores and ocular signs, tearfilm and symptoms were analyzed by Pearsons, differences between gender by *U*-test. The ability of MGL to predict dry eye symptoms was evaluated by area under the receiver operative characteristic curve (AUC).
Results: MGL scores were significantly correlated to lipid-layer pattern ($r = -0.68$, $p = 0.001$) NIBUT (−0.46, 0.032) OSDI (0.89, 0.001) and age (0.61, 0.005). MGL was significantly larger in female ($p = 0.001$). AUC of MGL was 95.8% ($p = 0.001$; sensitivity = 88.9%; specificity = 87.5%; threshold = 32.3%).
Conclusions: MGL is a predictive test of dry eye symptoms. The analyzed significant correlation between MGL and tearfilm and dry eye symptoms indicates the usefulness of the non-contact IR meibograph (PNCM).

1. Introduction

Meibomian Gland Dysfunction (MGD) is one of the most common abnormalities in ophthalmic practice [1] and the major cause of lipid anomaly [2] and therefore of the evaporative dry eye [3]. This was also recognized by the Tearfilm & Ocular Surface Society, which launched the International Workshop on Meibomian Gland Dysfunction (www.tearfilm.org/mgdworkshop/index.html) [3]. According the MGD Workshop, it is recommended to assess MGD by lid morphology, MG mass, gland expressibility, lipid layer and MG drop-out by meibography [3].

Meibography is a technique to visualize the morphology of the MG. There are two different principals: transillumination of the everted lid [4–6] versus direct illumination, named the non-contact meibography [7–10]. In transillumination the lid is everted over a light source [5,11] while non-contact meibography [10] consist of a slit lamp equipped with an infrared charge-coupled device video camera and an infrared transmitting filter [10] to allow the observation of the everted lid without contact to the instrument. To our knowledge, Jester et al. were the first describing meibography by infrared (IR) light [12] and subsequently many other groups used the transillumination IR techniques [4–6,10] in MG observation, but Arita et al. were the first introducing non-contact meibography [7–10]. The latter is commercially available but expensive.

The aim of this pilot-study was to analyze if a simple IR security video-camera is useful in meibography instead.

2. Methods

Meibographs (Fig. 1) were taken of the lower lid of 17 subjects (female = 10, male = 7; mean age = 44.3 years ±13.3 SD), randomly selected from the patient pool of the Horst Riede GmbH, Weinheim, Germany using a IR CCD video-camera (802CHA CCD; Shenzhen LYD Technology Co. Ltd., Shenzhan, China) which was adapted for near observation by adding a lens system (Figs. 2 and 3). This camera set-up was named the 'portable non-contact IR meibograph' (PNCM). Lipid layer and non-invasive tearfilm break-up time (NIBUT) were assessed by the TearScope Plus™ (Keeler Ltd, Windsor, UK). Symptoms were assessed by the Ocular Surface Disease Index (OSDI) and grouped into OSDI− and OSDI+ by a cut-off value of 15 [13,14].

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doi:10.1016/j.clae.2011.08.003

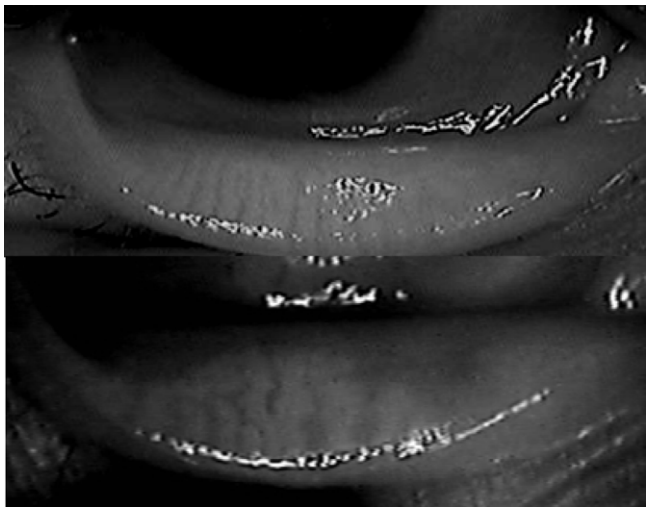

Fig. 1. Meibographs, taken by the portable non-contact IR meibograph (PNCM).

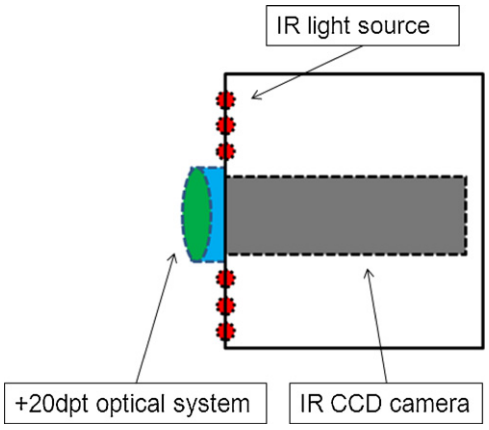

Fig. 2. Sketch of the portable non-contact IR meibograph (PNCM).

Fig. 3. The portable non-contact IR meibograph (PNCM).

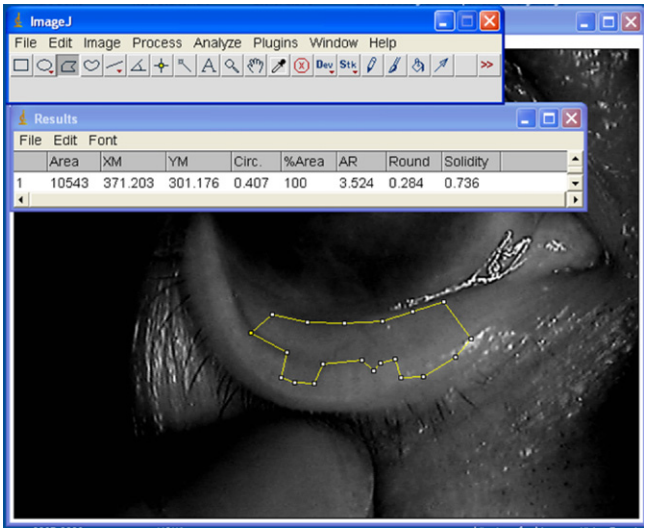

Fig. 4. Computerized analyses of MGL.

Observer was masked against OSDI scores; meibograph analyzes was masked against prior observations.

2.1. Inclusion and exclusion criteria

Subjects were excluded if they had diabetes, recent ocular infections, hay fever, any history of ocular surgery, use of any medication or eye drops known to affect the ocular surface, worn contact lenses or had contact lens experiences, or were pregnant. All procedures were conducted in accordance with the Declaration of Helsinki (1983). All subjects gave written informed consent before participating in the study.

2.2. Lipid layer

Lipid layer was observed using a TearScope Plus™ (Keeler Ltd., Windsor, UK) and classified by lipid pattern appearance according Korb et al. [15].

2.3. Non-invasive break-up time (NIBUT)

NIBUT was measured non-invasively using a TearScope Plus™ with a fine grid insert [16]. NIBUT was the time measured, in seconds, between the full opening of the eyelids after a complete blink and the first break in the tearfilm (using the included stop-watch of the TearScope Plus). Three consecutive readings were evaluated and the median noted.

3. Meibography

An IR CCD video-camera (802CHA CCD; Shenzhen LYD Technology Co. Ltd., Shenzhan, China) was adapted for near observation by adding a lens system (Figs. 2 and 3). The camera was connected to a computer via a Video-to-FireWire Converter DFG/1394-1e (The Image Source Europe GmbH, Bremen, Germany) and photographs were captured by the according software (IC Capture 2.0 and IC Imaging Control 3.1; The Image Source Europe GmbH). Photographs were then analyzed by ImageJ 1.42q (Wayne Rasband, National Institute of Health, USA). The area of MG drop-out was measured and its relation to the total-area calculated (Fig. 4). This factor was named MG loss (MGL).