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Editorial
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Handheld Tear Film Lipid Layer Thickness and Non Invasive Tear Break up Time Assessment Tool

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Tear Film Lipid Layer Diagnostics

Lipid layer is part of the tear film responsible for ocular surface lubrication and prevention of aqueous layer evaporation. Nowadays, dysfunction of this tear film layer is recognized as responsible for the majority of tear film dysfunction cases [1,2]. Yet, in the same time, no method of tear film lipid layer visualization became a part of routine clinical practice. Tearscope and Tearscope plus instruments, designed for lipid layer examination, were not widely accepted by general ophthalmologists or optometrists primarily because of their price, and furthermore are not being manufactured anymore [3]. Several methods, their use mainly confined to research or specialized dry eye clinics, assess Meibomian gland function (Meibometry, Meibomian gland expression, Meibography etc.). Currently, several sophisticated lipid layer assessent instruments are being developed, but despite their precision, their complexity and price will most likely limit their use to research and specialized dry eye clinics. Without questioning diagnostic capabilities of the above mentioned tests and equipment, it is quite clear that they did not find widespread clinical use, either due to the price of the equipment or to its impracticality, requiring time to perform or unacceptably interfering with other diagnostic procedures that are vital part of the routine clinical practice.

Physical Principles of Tear Film Lipid Layer Visualization

The appearance and thickness of the tear film lipid layer can be assessed by using interferometry [4]. It visualizes the lipid layer in the reflection of the light that is beamed at the surface of the eye. In order to get optimal results, the light needs to be strong, white, diffuse and as wide as practically possible (Figure 1). Semiquantitative interferometry uses opaque plate in front of the slit lamp beam. However, the area of cornea thus visualized is very tiny [5]. Tearscope uses spiral light source through which ocular surface is visualized by the slit lamp. While giving optimal results (visualizing the entire cornea), Tearscope is rather expensive, not being produced anymore and thus not widely used. It was obvious that a compromise method needed to be found, on the one hand being reliable enough, and on the other affordable and practical for everyday clinical use.

Handheld Tear Film Lipid Layer Thickness Assessment Tool

The author designed simple, cheap and practical instrument for tear film lipid layer assessment using widely available parts. By using interferometry method, wide and bright white light reflection from the tear film lipid layer visualized on the slit lamp is created simply by placing opaque white filter in front of the standard commercialy available handheld LED torch. It uses Class 1 light source: eye-safe under all operating conditions (LED and Laser Classification System in EN 60825-1 and IEC 60825-1) (Figure 2).

How to Use Handheld Tear Film Lipid Layer Thickness Assessment Tool

Being handheld, it is possible to use it in assessing LLT on different parts of the ocular surface and on different slit lamps. The instrument is brought obliquely as close as possible to the ocular surface to create widest reflection. It is possible to visualize some 20% of the corneal surface at the same time. However, the reflection can be moved to different parts of the ocular surface, thus completely visualizing lipid layer. The handheld tear film LLT assessment tool, despite its simplicity, showed clinically acceptable characteristics, making it possible to include LLT measurement in everyday ophthalmology and optometry practice. Furthermore, by shining the light very obliquely, it s possible to observe tear film breaks which essentialy represent visualization of non-invasive tear film break-up (Figure 3). By using this instrument, every eye care practician can incorporate tear film lipid layer diagnostics in his routine clinical work, as it is described below:

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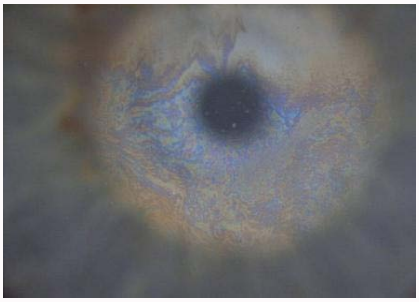

Figure 1: Lipid layer as seen using interferometry method.

Figure 2: Various models of Handheld Tear Film Lipid Layer Thickness Assessment Tool.

Figure 3: Using Handheld Tear Film Lipid Layer Thickness Assessment Tool.

How to Incorporate Lipid Layer Thickness Measurement in Tear Film Screening

- Interrelation between tests more important than results of individual tests!
- Cheap- only slit lamp, fluoresceine drops and handheld LLT instrument are needed.
- Minimally invasive (only fluoresceine instillation).
- Takes only 2.5 minutes!
- Scientifically-based, yet simple and quick enough to be advocated for everyday practice.
- Enables differentiation between hyperevaporative and hyposecretive dry eye.

1. Case history
2. Slit lamp examination of eyelid margin

a. Thickness, inflammation, uniformity (gland dropout).

3. LLT pre-blink

a. Initial lipid layer thickness assessment.

b. Appearance (clear, with detritus).

4. LLT post-blink.

a. Observe any change of lipid layer thickness or appearance after several forceful blinks.

b. Purpose: to establish whether reduced blink rate is the cause of thin lipid layer.

5. Unilateral Meibomian gland expression.

a. Dry eye is bilateral condition, therefore diagnostic procedures can be performed on only one eye.

b. Quantity/appearance of secretion observed.

6. Unilateral LLT after expression.

a. Thicker lipid layer after expression: lipid hyposecretion or obstruction.

b. Detritus in lipid layer: sign of meibum stasis (lipid hypersecretion-obstruction-blepharitis!).

c. Thin lipid layer before and after expression: gland atrophy or severe lipid hyposecretion.

d. Thick lipid layer+low TBUT before and after expression: aqueous layer dysfunction (aqueous hyposecretion).

7. Bilateral TBUT.

a. TBUT long before and after expression: stable tear film.

b. TBUT short before and long after expression: lipid layer dysfunction.

c. TBUT short before and after expression: aqueous layer dysfunction.

8. Ocular surface staining.

Conclusion

Handheld LLT assessment tool has proven in practice to be dependable, while in the same time practical due to its small size and only slightly more expensive than ordinary handheld torch. The author of this instrument hopes that it will help ophthalmologists and optometrists to make tear film lipid layer examination a part of their routine clinical practice, as well as observing tear film stability non-invasively.

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