

ALL-IN-ONE AUTOMATED MEASUREMENT OF OCULAR SURFACE PARAMETERS

LacryDiag from Quantel Medical simultaneously conducts four essential, noncontact, dye-free exams of the ocular surface for the diagnosis and monitoring of dry eye.

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Dry eye syndrome (DES) affects millions of people throughout the world and is one of the most frequent causes of patient visits to eye care practitioners. It is a symptomatic disease, characterized by a vicious cycle of tear film instability and hyperosmolarity, which leads to increased ocular surface inflammation, damage, and neurosensory abnormalities.¹ In most cases, DES can be successfully managed if diagnosed early and properly treated. For patients, DES can be relentlessly uncomfortable, leaving them to a lifetime of applying artificial tears (drops) and ointments daily for temporary relief of dry eye irritations. From a physician's perspective, not having an accurate diagnosis of underlying conditions not only leads to superficial treatment protocols, and some guesswork, but also leaves a greater risk of undiagnosed DES, potentially causing vision loss.

Fortunately, today, diagnostic procedures to detect DES are evolving. To create an evidence-based definition and a contemporary DES classification system, experts of the 2017 Dry Eye Work Shop (DEWS II report) have redefined the diagnostic methodology to include a comprehensive ocular surface examination specific for diagnosing DES (Figure 1).² There are two phases of this methodology.

The first phase is to determine DES and homeostasis through one of three tests: Non-Invasive Break-Up Time (NIBUT), ocular surface staining, or osmolarity tests. Once this is complete, the second phase aims to determine the subtype of DES. For this, several different exams are required to identify an evaporative form using interferometry and meibography or to identify aqueous deficiency using tear meniscus height.²

In order to provide a more accurate diagnosis of DES, and to determine the underlying deficiencies, the experts proposed the modification of two tests: the classic tear film break-up time using fluorescein eye drops^{3,4} and the Schirmer test.^{5,6}

In tear film break-up time, the fluorescein dilutes the natural tears and logically modifies their physical properties providing an inaccurate tear film break-up time evaluation. To address this issue, it is now recommended to use dye-free imaging known as the NIBUT test (Figure 2).^{7,8} The Schirmer test uses paper strips inserted into the eye for approximately 5 minutes to determine

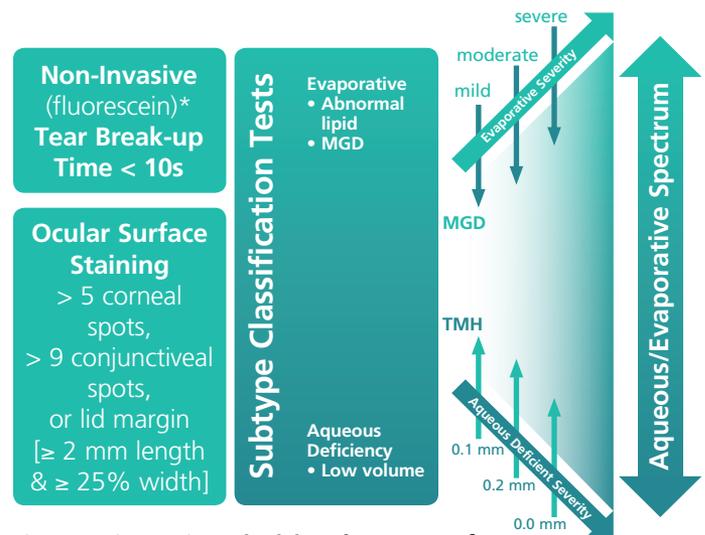


Figure 1. Diagnostic methodology from DEWS II.²



Figure 2. NIBUT test.

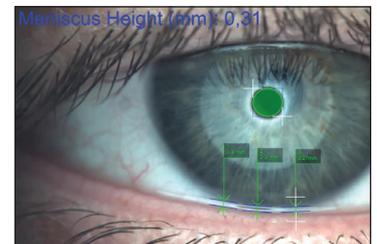


Figure 3. Noncontact tear meniscus.

the production of tears. One issue is that eye contact with the paper causes reflex tearing that can distort the test and provide an inaccurate reading. For more accurate readings, it is recommended to use a noncontact imaging method measuring river height or if tear meniscus is present (Figure 3).

A New, Innovative Diagnostic Tool

With an aim to introduce a dye-free, noncontact method to diagnosing DES, a new ocular surface analyzer and medical imaging device—LacryDiag (Quantel Medical)—emerged. LacryDiag simultaneously conducts four essential, noncontact, dye-free exams of the ocular surface for the diagnosis and monitoring of DES: they are

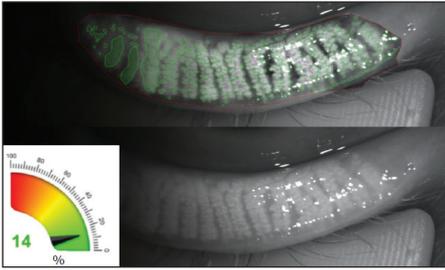


Figure 4. Meibography.

NIBUT, tear meniscus, interferometry, and meibography.

Noncontact meibography is an imaging study for the purpose of observing the morphology of meibomian glands in real

time.⁹ The meibomian glands in the eyelids secrete meibum, a lipid complex that forms the lipid layer of the tear film. The lipid layer prevents evaporation of aqueous tears and subsequent drying. Lipid deficiency due to meibomian gland dysfunction is the most common cause of symptoms associated with DES.¹⁰ A unique feature of the LacryDiag is the ability to classify various levels of meibomian gland dysfunction automatically (Figure 4).

Thanks to its yellow filter and blue light, LacryDiag can also perform ocular staining exams with fluorescein; blepharitis and demodex imaging can also be analyzed with this product.

Case Study

In the following case, a volunteer patient with previously diagnosed DES was examined using the LacryDiag. The device sequentially performed the following four, noncontact tests semi-automatically and produced a rapid, graphic representation (color coded) of all four tests (Figure 5).

The Results of the Test Are as Follows:

1. In this case, the height of the tear meniscus measurement was 0.18 mm in the right eye and 0.14 mm in the left eye. Measurement of the height of tear meniscus, which is a surrogate criterion for the tear volume, was achieved thanks to two calipers placed by the observer on the lacrimal river. The lacrimal river was discontinuous and thin.
2. Interferometry detected an instable lipid layer of the tear film, shortly visible (1 or 2 seconds) due to severe tear deficiency (≈ 30 nm: close meshwork for both eyes).
3. Meibography by infrared imaging of meibomian glands and image analysis detected the glands were visible with a low loss, estimated at 14% in the right eye and 16% in the left eye.
4. The NIBUT was measured at 3.3 seconds in the right eye and 6.8 seconds in the left eye.

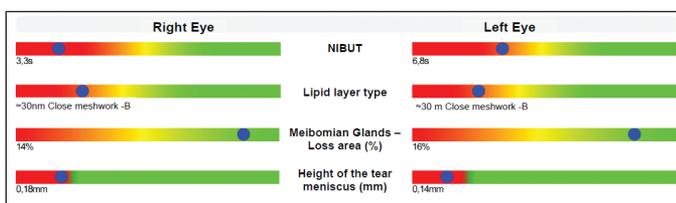


Figure 5. Exam report of case study patient.

Results

The four parameters were obtained on both eyes within 10 minutes. From the exam report, we determined this patient's DES was mainly due to aqueous deficiency without significant meibomian gland dysfunction. Enhancing our patient education protocols, the graphical representation helped illustrate and explain the pathology to this patient. If needed, the device can also measure the classical BUT and corneal topography.

Conclusions

To the best of our knowledge, the LacryDiag is the first noncontact ocular surface analyzer and medical imaging device to perform the four necessary exams simultaneously to comprehensively detect and diagnose DES. ■

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