All-in one automated measurement of ocular surface parameters: interferometry, tear meniscus, non-invasive break-up time and meibography

COURRIER E[1], TRONE MC[1,2], RENAULT D[1,3], LAMBERT V[1,2], LAZREG S[4], THURET G[1,2,5], GAIN P[1,2]

1-Corneal Graft Biology, Engineering and Imaging Laboratory, EA2521, Faculty of Medicine, Jean Monnet University, St-Etienne, France
2-Department of Ophthalmology, University Hospital, Saint-Etienne
3-Laboratoires Théa, Clermont-Ferrand, France
4-Private clinic, Blida, Algeria
5-Institut Universitaire de France, Bd St Michel, Paris, France

Corresponding author: emilie.courrier@univ-st-etienne.fr

PURPOSE

Diagnosis procedures in the dry eye syndrome (DES) are evolving. The experts of the 2017 Dry Eye WorkShop (DEWSII 2017)[1,2] proposed to modify two tests: 1/ the classic tear film break-up time of (BUT) using fluorescein eye drops[3,4]. When instilled, the fluorescein dilutes the natural tears and logically modifies their physical proprieties and thus the BUT evaluation. It is now recommended to use a dye-free imaging: the Non-Invasive BUT (NIBUT)[5,6]; 2/ the Schirmer's test measuring the length of a strip of blotting paper impregnated by tears after 5 minutes[7,8]. Contact with the paper causes reflex tearing that distorts the test. It is now recommended to use a non-contact imaging method measuring river height or tear meniscus *in situ*.

Aim: to present a new device that simultaneously measures at least four parameters of the ocular surface indicated for the diagnosis and monitoring of DES: NIBUT, lacrimal river height, interferometry and meibography.

Figure 1. The LacryDiag device

METHODS

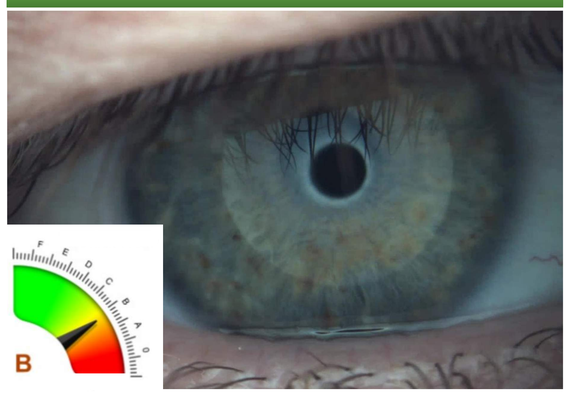
LacryDiag (Quantel Medical, Clermont-Ferrand, France) is a new CE marked medical imaging device. We present the first use in a volunteer patient with known DES. The device sequentially performed **semi-automatically**: 1/measurement of the **height of tear meniscus**, which is a surrogate criterion for the tear volume, thanks to 2 calipers placed by the observer on the lacrimal river; 2/ **interferometry** that provided quantitative and qualitative analyze of the lipid layer of the tear film depending on its thickness and regularity, using a comparison with a set of videos; 3/ **meibography** by infrared imaging of Meibomian glands and image analysis (automatic boundaries detection + manual corrections whenever necessary); and 4/ **automatic NIBUT** by image analysis of placido's disk. A graphic representation (color code) provided rapid interpretation of the 4 tests.

RESULTS

1) Height of the tear meniscus

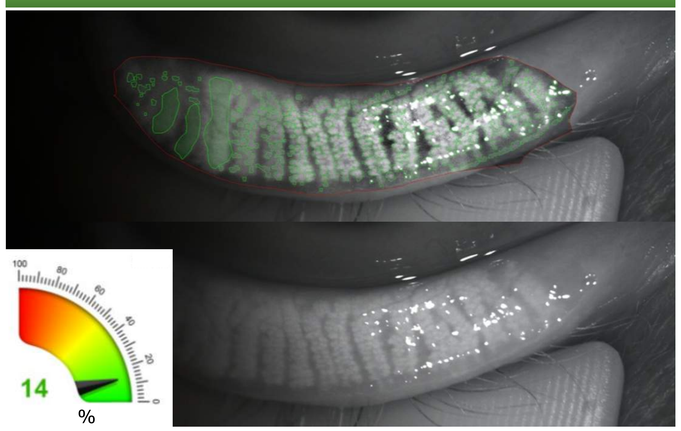
The height of the tear meniscus measurement was 0.18mm.
The lacrimal river was discontinuous and thin.

2) Interferometry



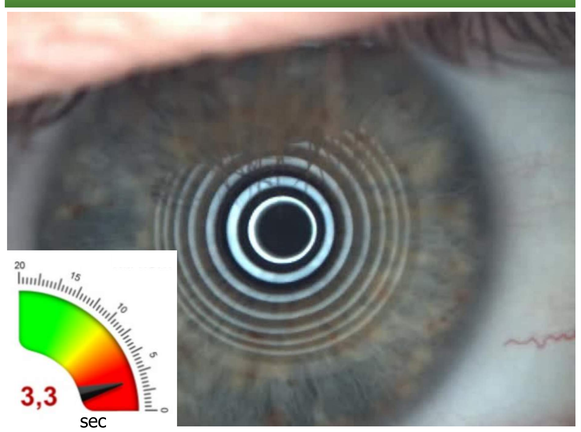
An instable lipid layer, shortly visible (around 1/2sec) due to severe tear deficiency was detected (≈30nm: close meshwork).

3) Meibography



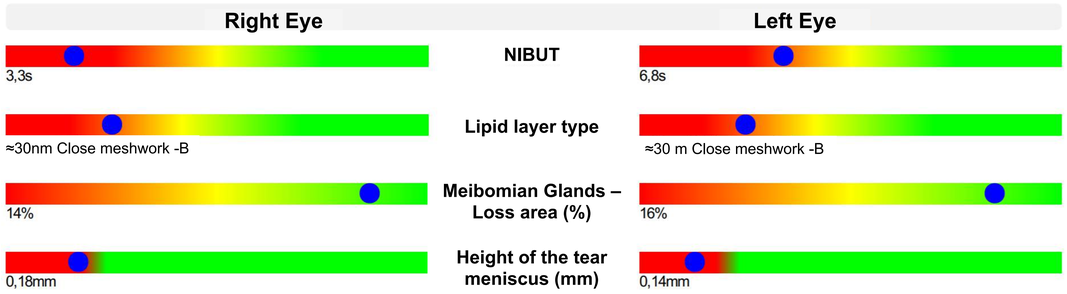
The Meibomian glands were well visible with a low loss, estimated at 14%.

4) NIBUT



The NIBUT was measured at 3.3 sec.

5) Exam report



The four parameters were obtained on both eyes in 10 minutes.
The device allowed diagnosing a DES mainly due to aqueous deficiency without significant Meibomian gland dysfunction.
The graphical representation is intended to help the physician explain the pathology to patients.

The device can also measure the classical BUT and corneal topography.

CONCLUSIONS

To the best of our knowledge, this new device is the first to perform these 4 measurements simultaneously.
Non-invasive measurements are in conformity with the recent Dry Eye Workshop II recommendations.

REFERENCES

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